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ELECTRICAL WORLD

May 14, 1932
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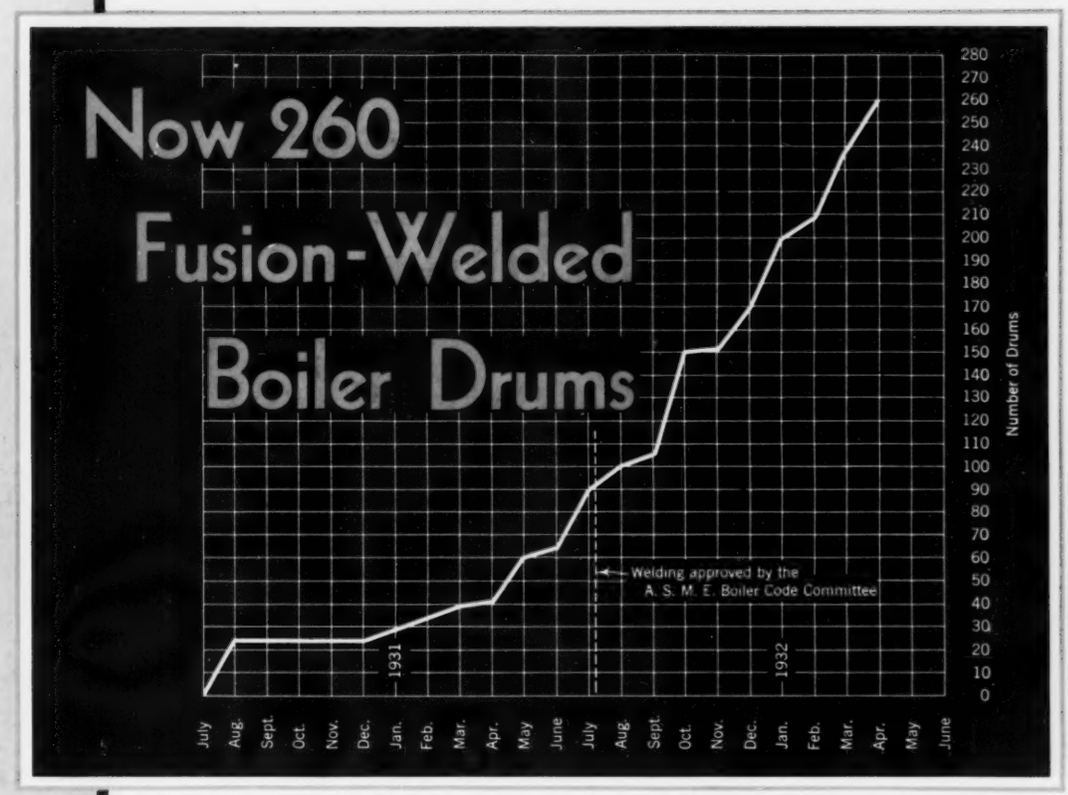

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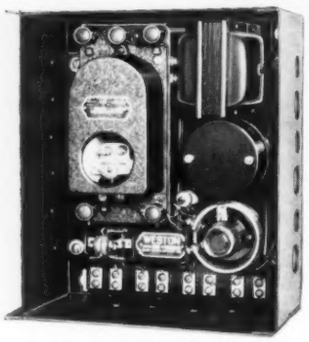

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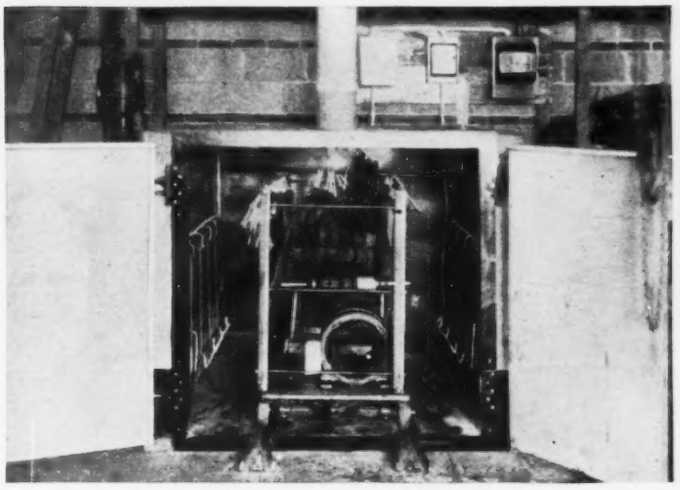

Armature baking oven at repair shop of Lydon Bros., Trenton, N. J.

MAY 14, 1932

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1831 — MORE THAN 100 YEARS of PROGRESS IN WIRE MAKING — 1932

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ELECTRICAL WORLD

Established 1883. McGraw-Hill Publishing Company, Inc.

for the Week Ending

May 14, 1932

"Why a Sound Plan Failed and Was Repealed"

—**Bond & Share stock plan** explained by directors who were responsible for it. Stockholders circularized by two groups, and Wall Street recalls that officers and directors are registered holders of less than one-fifth of 1 per cent of outstanding shares—*p. 839.*

—**Waukegan rated at 290,000 kw.** as fifth unit is installed. This important station of Public Service Company of Northern Illinois has unit mill firing, generator air cooling, metal-clad switch gear and a 115,000-kw. single-winding generator unit—*p. 852.*

8,000,000-kw. development for Northwest?

—**Columbia River development** would be achieved at a probable cost of $740,000,000 and have an 8,000,000-kw. capacity, says War Department engineer in his report. Nine sites in addition to Rock Island included—*p. 834.*

—**Economical substation design** developed by Byllesby engineers in cumulative effort to better results. Extensive use of outdoor principle and its application to 4-kv. structure a feature at Sewickley—*p. 860.*

N.E.L.A. announces Atlantic City program

—**Convention plans crystallize** as date of annual meeting approaches. Refrigeration, energy sales promotion, policies of the association to be topics. Exhibition will be a center of activity—*p. 834.*

—**New England engineers hear** of further advances in the electrical art. Use of double conductors for transmission lines, parallel-type inverters and capacitor motors were among subjects discussed—*p. 837.*

Process steam no bar to purchasing energy

—**Purchased power has a place** even in process-steam industries, says consulting engineer for one of the largest organizations in that group. As evidence he shows that of 81 plants in the group 57 purchase all power, eleven purchase partly and thirteen generate own energy—*p. 857.*

Timeliness the Essence of Atlantic City Program of N.E.L.A.

TOPICS of an academic or a routine nature will be absent from the program now being arranged for the fifty-fifth convention of the National Electric Light Association, to be held at Atlantic City on June 6 to 10, or at any rate will be subordinated to those with an immediate practical flavor. Pressing business problems of the industry demanding specific and prompt adjustment will have the floor and motivate the delegates. With this much decided on the skeleton program is rapidly taking on flesh. So far its appearance is as follows:

FIRST GENERAL SESSION

TUESDAY MORNING, JUNE 7

Address of welcome, Mayor Bacharach.
Presidential address, J. F. Owens.
Address, "The N.E.L.A.—Its Work and the Electrical Industry," B. C. Cobb, chairman finance committee.
Report of committee on constitution and bylaws, R. F. Pack.
Treasurer's report, Edward Reynolds, Jr.
Report of Public Relations National Section, D. C. Green.
Address, Charles F. Kettering, president General Motors Research Corporation.
Address, B. F. Weadock, executive director.

SECOND GENERAL SESSION

WEDNESDAY MORNING, JUNE 8

Address, Vice-President P. M. Downing.
Address, D. F. Kelly, president "The Fair," Chicago.
Report of Commercial National Section, T. O. Kennedy.
Report of exhibition committee, E. W. Goldschmidt.

THIRD GENERAL SESSION

THURSDAY MORNING, JUNE 9

(*Edison Memorial Session*)

Address, Thomas N. McCarter.
Address, "What the Machine Is Doing to Mankind," James S. Thomas, Alabama Power Company.
Report of Engineering National Section, A. H. Kehoe.

PUBLIC POLICY SESSION

THURSDAY EVENING, JUNE 9

Address, Floyd L. Carlisle.
Report of public policy committee, P. S. Arkwright.

FOURTH GENERAL SESSION

FRIDAY MORNING, JUNE 10

Report of memorial committee, W. H. Onken, Jr.
Report of prize awards committee and presentation of awards, Frank W. Smith.
Report of Accounting National Section, J. H. Lobban.
Address, "Public Interest in Electrical Merchandising," Kenneth Dameron, secretary joint merchandising committee.
Address, "New Tools for the New Age," C. M. Ripley, General Electric Company.
Election of officers.

ACCOUNTING SESSION

TUESDAY AFTERNOON, JUNE 7

Chairman's address, J. H. Lobban.
Address, W. Paxton Little, chairman advisory council.
Discussions on appliance sales accounting, credits and collections, standardization of financial reports, retirement accounting theory, advantages of property records, budgets, and geographic division co-operation and co-ordination, led by selected speakers.

ENGINEERING SESSION

TUESDAY AFTERNOON, JUNE 7

Chairman's report, A. H. Kehoe.
Address, with demonstration of new technical developments, Samuel M. Kintner, vice-president Westinghouse company.
Address, "Engineering as Process of Business," J. C. Parker, president Brooklyn Edison.
Address on operating engineer problems (speaker not yet selected).

COMMERCIAL SESSION

WEDNESDAY AFTERNOON, JUNE 8

Chairman's address, T. O. Kennedy.
Address, President J. F. Owens.
Report of Electric Refrigeration Bureau, J. E. Davidson.
Report of home-lighting committee, W. A. Jones.
Report of National Electric Cookery Council, P. S. Arkwright.
Other features.

PUBLIC RELATIONS SESSION

THURSDAY AFTERNOON, JUNE 9

Chairman's address, D. C. Green.
Address, "Taxation," George T. Buckingham, vice-president Illinois Power & Light Corporation.
Addresses by prize-winning speakers in national employees' speaking contest and presentation of awards by President Owens.

Preparations for the manufacturers' exhibition are also under full headway. One of the general sessions—that on Wednesday—will be held on the stage of the exhibition hall.

▼

Mississippi Sales Tax Finally Becomes Law

Although, as reported in the ELECTRICAL WORLD for April 23, the revenue bill imposing a general sales tax lacked two votes of the requisite three-fifths majority when the Lower House of the Mississippi Legislature voted on it after its passage in the Senate, the forces behind the measure proved strong enough to bring about a reconsideration. On the second vote the House passed the bill. The Governor at once signed it, and it became law on the first of this month. Mississippi is believed to be the first state to undertake to raise revenue in this way.

The bill, as passed, imposes a tax of 2 per cent on all sales with certain exceptions where sales are untaxed or taxed at only half that rate. The 2 per cent tax applies to the gross receipts of all public utilities except those from industrial power. On industrial power sales the tax is 1 per cent. There is no state regulation of light and power utilities in Mississippi, and presumably domestic customers of both private and municipal plants will find the tax added to their monthly bills.

▼

War Department Engineer Reports on Columbia River

Nine sites, exclusive of Rock Island, could supply 8,000,000 kw. Total development cost about $740,000,000.

In a report to the Secretary of War concerning navigation and power development on the Columbia River, with incidental reference to irrigation and flood control, Major-General Lytle Brown, chief of engineers, gives the following summary of possible hydroelectric output and its cost:

The Columbia River and its tributaries are susceptible of being developed into the greatest system for water power to be found anywhere in the United States. The power can be developed at low cost. The sites determined by the Board of Engineers for Rivers and Harbors as most promising, all things considered, are at ten localities, namely: (1) Head of Grand Coulee, Wash.; (2) Foster Creek, Wash.; (3) Chelan, Wash.; (4) Rocky Reach, Wash.; (5) Rock Island Rapids, Wash.; (6) Priest Rapids, Wash.; (7) Umatilla Rapids, Ore.; (8) John Day Rapids, Ore.; (9) The Dalles, Ore.-Wash.; (10) Warrendale, Ore.-Wash. Of these the one at Rock Island Rapids is under construction by private enterprise.

The structures contemplated in the scheme for power development are all on a large scale, some on a grand scale, and the conditions at some of them as to foundations and flood discharge over the dams are without precedent. There is nothing, however, to cause a belief that the engineering difficulties cannot be surmounted. There is a desire, which is natural, to make more extended engineering investigations at this time. I believe that there are enough data on hand on which to base any major decisions that may be required by federal authority. Detailed investigations will be in order following these decisions or they may be unnecessary.

The [total ?] cost of this development will exceed that of any other single development of any kind for power that has

ever been made. Assuming money at 4 per cent, the estimated costs of these power installations including interest during construction are as follows: Grand Coulee, $204,500,000; Foster Creek, $49,000,000; Chelan, $39,000,000; Rocky Reach, $38,000,000; Priest Rapids, $63,000,000; Umatilla Rapids, $60,000,000; John Day Rapids, $110,000,000; The Dalles, $89,000,000; Warrendale, $59,000,000. Total of these developments, about $711,000,000. If money is at 6 per cent, the total would be about $772,000,000. The Grand Coulee and The Dalles installations are outstanding because of size. The ultimate development to be foreseen would have an installed capacity of about 8,000,000 kw. The Grand Coulee development alone would be able to meet any probable increase in power needs of the accessible area for a period of 30 years in the future.

Major-General Brown recommends that power developments on the Columbia River be made in strict accordance with the federal water-power law and in accordance with the authorized plan for combined development for navigation and power. He cites Elwood Mead, Commissioner of Irrigation, as in general concurrence with his views. Dr. Mead's opinions were quoted in the ELECTRICAL WORLD for January 30 (page 209) and a dissenting view by Secretary of Agriculture Hyde in the issue for February 13 (page 298).

▼

Bill to Give Power Board Rate-Adjusting Function

By the terms of a bill amending the federal power act introduced by Senator Norris of Nebraska and Representative Shallenberger of Alabama, it would be unlawful for a utility company under the Federal Power Commission's jurisdiction or for any utility transmitting electrical energy across a state boundary to sell power in one community at a rate higher than in another similar community unless there were a difference in the cost of production. In case of such a difference the fluctuation in rates would not be permitted to exceed the percentage of variation. The amendment provides that the new provision be applied equally to interstate and intrastate companies.

Enforcement would be placed entirely in the hands of the Federal Power Commission, which would be empowered to act upon the receipt of any complaint as to diversity of rates not attributable to disparities in production costs. Municipal plants are expressly excluded from the provisions of the bill, but it is provided that when a seller of electricity has in any community the competition of a municipal corporation selling energy to the public at rates which do not fully reimburse the municipality, the rates of such seller in that community shall not be considered in determining the propriety of rates in other communities.

The amendment has been referred to the Senate interstate commerce committee, which is headed by Senator Couzens of Michigan.

▼

Trade Inquiry Shifts from Byllesby to Bond & Share

Four days last week were added to the four taken in the week before to hear the voluminous testimony of the Federal Trade Commissioner's experts in the investigation of the Northern States Power Company. Calvin C. Davis, one of these experts, testified on Thursday and Friday concerning the subsidiary Minneapolis General Electric Company. This examiner found a net "write-up" in the capital assets of the Minneapolis company at the close of 1929 of $14,203,730, or approximately 25 per cent of the total. This included discount on bonds, which was eliminated in making up the consolidated balance sheet of the Northern States Power, reducing the amount to $6,315,634.

In concluding his testimony Mr. Davis said that the circumstances affecting the investments and earnings of the Minneapolis company indicate that earnings are of an artificial character and do not show the normal economic results. This, he said, is due to the fact that the Northern States Power Company operates the properties of the Minneapolis General Electric merely as one division among several "in a power pool," with arrangements for the contribution of power to and charges for taking it from the pool of the common circuit.

The examiner testified that the total average investment in the Minneapolis company increased from a little under $12,965,000 in 1913 to nearly $45,926,000 in 1929; but his own computations, which eliminate appreciations from book values, show that the 1929 figure was $36,859,000.

On May 10 the inquiry again shifted, Byllesby utilities giving way to the Electric Bond & Share group as affairs of the Louisiana Power & Light Company, a subsidiary of the Electric Power & Light Corporation, were taken up.

Recession of Indexes Continues

AN APPEAL to Congress by President Hoover for action in the present crisis resulted in the appointment of a Senate bipartisan economy committee of six members this week with the likelihood of a balanced budget considerably improved. A $300,000,000 saving is one goal.

Basic indexes continue to slump. Car loadings fell about 1 per cent. Unfilled orders for steel touch a new low and show the 23 per cent activity prevailing during April to be scarcely justified. Electrical energy production is 12.7 per cent below last year, the greatest falling off being in central and Chicago districts.

Security markets grew firmer last week, though showing no marked strength. "Electrical World" average for 50 common stocks stood at 24.6. Rumors that efforts by Federal Reserve authorities to secure co-operation for international credit expansion program have met with no success are heard.

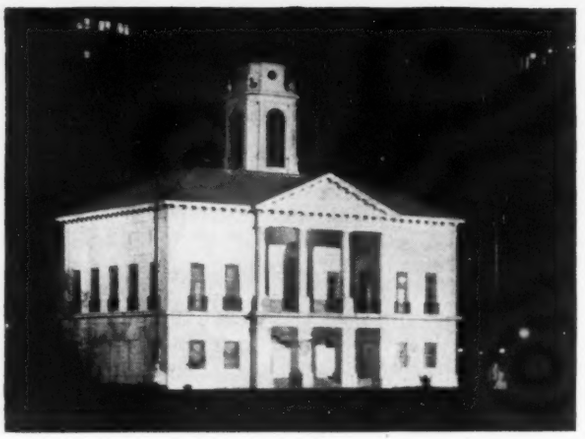
▼

Muscle Shoals Bill Passes Lower House

BY A VOTE of 183 to 132 the House of Representatives passed on May 5 the Muscle Shoals bill sponsored by Representative Hill of Alabama and favorably reported from the committee on military affairs by Representative McSwain of South Carolina. As previously reported in the ELECTRICAL WORLD, the bill provides for the leasing for 50 years of the nitrate plants (Nos. 1 and 2) and other facilities for the manufacture of fertilizer, fertilizer ingredients and other chemicals. No power-distributing or allied company will be considered as a lessee, and the power plants and power-generating facilities will not be leased, but maintained by the government, which will sell the necessary power to the lessee. If no lessee can be found in eighteen months, then the government, through the board to be appointed by the President, will itself proceed to manufacture fertilizer for storage and sale in accordance with market demands, subject, however, to the instruction to conclude such a lease subsequently if this can be effected. Cove Creek Dam is to be built by the government on authorization by Congress if increased demand for fertilizer makes this desirable, subject to recapture by Tennessee at the expiration of 50 years.

Representative Hill declared his belief that a lessee would be found and that the bill would assure large returns to the government. The bill now goes to the Senate, but it is freely predicted that that body will reject it and prefer the twice-vetoed government-ownership bill of Senator Norris, which is again before it.

LIGHTING PLAYS ITS PART IN COMMEMORATING WASHINGTON



New York City helped celebrate the two hundredth anniversary of Washington's birth by erecting a replica of the Mount Vernon homestead in Prospect Park, Brooklyn, and one of Federal Hall in Bryant Park, Manhattan.

—Keystone View Co.

▼

Commerce Dominates Southeastern Conference

Almost entirely commercial in tone, except for an able discussion on valuation and rate trends, the conference of the Southeastern Division, N.E.L.A., held recently at Atlanta in lieu of the customary annual convention, put particular stress on trade relations. Every state in the division was represented by executives of member companies, to a total number of 100, and a serious intent on their part to make a co-operative effort to meet changing conditions was evident.

Air conditioning and the other load-building possibilities through co-operation with the ice industry, the aims of the Electric Cookery Council, relations with outside dealers, merchandising of appliances, the value of market analysis, and holding industrial customers through the aid of the engineering and operating departments, were discussed, outside specialists taking part with prominent utility men from the Southeast and national headquarters.

New officers are: President, L. A. Magraw, president South Carolina Power Company; first vice-president, J. W. Hancock, manager Appalachian Electric Power Company; second vice-president J. M. Barry, vice-president Alabama Power Company; third vice-president, J. G. Holtzclaw, president Virginia Electric & Power Company.

▼

Southwesterners Discuss Many Topics of the Day

The myth of taxless cities under municipal ownership, the tendency of the government to encroach upon private business, the merchandising problem, the progress of internal-combustion engines and the future of air conditioning for homes were outstanding topics at the twelfth annual convention of the Southwestern Division of the N.E.L.A., held in Hot Springs, Ark., April 26 and 27.

Ex-Governor Moody of Texas and William Townsley, editor of the Great Bend *Tribune* in Kansas, discussed the utility merchandising problem. Former Governor Moody maintained that the sale of electrical appliances was an implied right of the utilities and benefited the public. This subject was discussed at length from the floor.

J. B. Wootan, editor of the *Public Service Magazine*, recited facts and figures to show that "taxless" cities paid taxes. John Spargo spoke. Feature speakers on the public policy evening program were Gus W. Dyer, editor of the *Southern Agriculturist*, and Frank A. Merrick, president Westinghouse Electric & Manufacturing Company.

S. R. Bertron, Jr., president Houston Lighting & Power Company, was elected president of the association; S. E. Wolff of Oklahoma, F. M. Wilkes of Arkansas, A. B. Paterson of Louisiana, L. V. Sutton of Mississippi and W. H. Thomson, Jr., of Texas were made vice-presidents, and S. J. Ballinger re-elected secretary.

▼

Dominion and Province Form St. Lawrence Plan

Ottawa advices say that, after long negotiations on the subject, the Canadian federal government and the government of Ontario have reached an agreement in regard to plans for the Ontario side of the international section of the St. Lawrence waterway. The 1,000,000 hp. will cost Ontario about $120,000,000, including power houses, equipment and transmission lines. The cost at the source is calculated at $12 per horsepower, but when the power is "stepped up" it will be $15, the same amount as is paid under the contract between the Ontario Hydro-Electric Power Commission and the Beauharnois company.

▼

San Joaquin Rate Cut Put Tentatively at $650,000

A total reduction of $650,000 in the rates of the San Joaquin Light & Power Corporation has been put forward tentatively as a proper figure by the California Railroad Commission. In accordance with its decision noted in the ELECTRICAL WORLD for April 2 (page 594), the commission held further hearings with those who had participated in the long-drawn-out rate proceedings in an endeavor to negotiate an allocation of the total reduction that would be acceptable to the various classes of customers. The San Joaquin company protested against the proposed amount of the reduction but asked that if it was enforced the benefit of the reduction be given to urban communities. Representatives of the California Farm Bureau Federation, the ice interests and owners and managers of buildings made suggestions for the spread, as did three witnesses representing 50 oil companies, G. R. Kenny, city rate export of Fresno, and Paul Lebenbaum, representing the Fresno Traction Company.

The commission is still working on the allocation, and its decision may not be announced until next month. One unofficial prediction is that $200,000 will be taken from rural rates and $450,000 from domestic and commercial lighting.

Wisconsin Commission Starts Novel Inquiry

Announcement was made by the Wisconsin Public Service Commission on May 9 that, beginning on May 11, it would conduct a week's investigation of the effect of the economic depression upon the people and industry of the state, with particular reference to the bearing which these conditions may have upon the commission's duties in the regulation of public utilities. The commission will hear the views of economists from various parts of the country and listen also to testimony prepared at its request by other departments of the state.

This testimony will be given in the course of a state-wide telephone investigation now going on, but will go outside the field of that inquiry to look into the extent of unemployment, the state of agricultural prices and incomes, commercial bankruptcies, bank failures, the cost of public relief, the effect of the depression on the earnings of manufacturing and retail corporations, the decline of individual and corporate income and other related subjects. This is expected to give a picture of the conditions of the users of utility services—farmers, wage earners, business men, mercantile and manufacturing corporations and certain financial institutions. The commission's staff will then summarize the effect of the depression upon the various classes of utilities.

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Engineers Explain New Refinements

Multiple conductors, stability in transmission, calculations for induction motors and stray-load loss among the subjects discussed at Providence.

EXTENSION of engineering control to achieve longer transmissions, improved machinery design, better handling of highway traffic and other diversified topics filled the program of the Northeastern District meeting of the American Institute of Electrical Engineers at Providence, R. I., on Thursday and Friday of last week under the general chairmanship of Vice-President I. E. Moultrop.

Papers on the usefulness of multiple conductors in transmission aroused much interest, the theoretical advantages of this type of construction for mild climates being set forth by H. B. Dwight and E. B. Farmer of the Massachusetts Institute of Technology and C. A. Boddie of the Boddie Electrophysical Laboratories, Wilkinsburg, Pa. Numerous curves and formulas of interest to line designers were presented by Edith Clarke of the General Electric Company for various multiple-conductor arrangements. In the discussion the operating problem associated with ice formation was stressed as a handicap to this type of construction in northern districts, as well as the increased cost of supporting structures and of erection and difficulties of maintaining proper spacings and clearances at all times in the multiple-conductor system. W. W. Lewis asserted that computations for a 300-mile transmission of 500,000 kw. with multiple and separate conductors at 345 kv. show insufficient economy to warrant changing from present methods. F. W. Daggett, Philadelphia Electric Company, and E. W. Dillard, New England Power Association, questioned the value of multiple-conductor transmission in the face of present economic and operating obstacles, although the usefulness of analyses looking toward the application of higher voltages through control of corona formation was recognized. Prof. V. Karapetoff declared that multiple-conductor transmission must be weighed in important projects of the future as an alternative method.

Further progress toward the effective control of stability conditions in transmission was emphasized in papers by S. B. Crary, M. L. Waring and F. A. Hamilton of the General Electric Company on torque-angle characteristics of synchronous machines following system disturbances and on field tests to determine their damping characteristics. Tests on the New York Power & Light Company system near Albany provided graphic information of value. Low-resistance damper windings were found to aid the rapid smoothing out of balanced disturbances caused by line switching, synchronizing, load changes, tripping of loaded generators and three-phase shorts. The tests indicated that the generator field-circuit resistance can be varied within normal limits without greatly affecting damping characteristics.

Increased speed and accuracy in the calculation of induction-motor performance was featured in a paper by C. G. Veinott of the Westinghouse company. The author's single-phase calculation method is based upon the cross-field theory with the solution of three simultaneous equations for the currents in the three circuits of the motor. The rotor speed is the independent variable. The polyphase calculation method is based upon the equivalent circuit, the latter being based upon the revolving-field theory, with the slip as the independent variable. The method distinguishes between primary and secondary leakage and saves much time and labor. R. E. Hellmund pointed out that by continuous improvement and refinement of motors the designer has created new problems for himself which are constantly leading him on toward greater accuracy of computation and prediction of test results. The purchaser has been the beneficiary of the trend toward the production of motors with increased output per unit volume and of improved efficiencies.

C. J. Koch, General Electric Company, in a paper on the measurement of stray-load loss in polyphase induction motors, outlined several methods applicable to both slip-ring and squirrel-cage designs and suggested that these be taken as a basis for the revision of the Institute standards so as to require the inclusion of induction-motor stray-load loss in efficiency determination. The author recommended that full-load current be normally used for squirrel-cage and ball-bearing motors, with values of 150 per cent full-load current for normal use on sleeve-bearing motors under 25 hp. The method is superior to the use of the dynamometer in some cases. P. H. Trickey, Westinghouse company, described a convenient method of calculating full-load conditions for capacitor motors operating under balanced power conditions. Other papers revealed progress in gas-filled vacuum-tube development, the broadening scope of electrical signal systems for traffic handling, and the production of sub-harmonic frequencies from non-linear systems.

Coming Meetings

National Electrical Manufacturers' Association—Hot Springs, Va., May 15-20. A. W. Berresford, 420 Lexington Ave., New York.

Middle West Division, N.E.L.A. — Muehlebach Hotel, Kansas City, Mo., May 18-20. Thorne Browne, 1527 Sharp Bldg., Lincoln, Neb.

East Central Division, N.E.L.A.—Commodore Perry Hotel, Toledo, Ohio, May 24-27. D. L. Gaskill, 603 Broadway, Greenville, Ohio.

National Electric Light Association — Atlantic City, N. J., June 6-10. A. J. Marshall, 420 Lexington Ave., New York.

Pacific Coast Electrical Association—Hotel Huntington, Pasadena, Calif. June 14-17. K. I. Dazey, 447 Sutter St., San Francisco.

Canadian Electrical Association—Manor Richelieu, Murray Bay, Que., June 15-17. B. C. Fairchild, 409 Power Bldg., Montreal.

Public Utilities Advertising Association—Waldorf-Astoria, New York, week June 19. J. R. Pershall, Public Service Co. of Northern Illinois, Chicago.

American Institute of Electrical Engineers—Summer convention, Cleveland, June 20-24. Acting secretary, 33 West 39th St., New York.

American Society for Testing Materials—Chalfonte-Haddon, Atlantic City, June 20-24. C. L. Warwick, 1315 Spruce St., Philadelphia.

American Society of Mechanical Engineers—Bigwin Inn, Lake of Bays, Ontario, June 27-July 1. C. W. Rice, 29 W. 39th St., New York.

New England Division, N.E.L.A.—Mount Washington Hotel, Bretton Woods, N. H., July 11-13. Miss O. A. Bursiel, 20 Providence St., Boston.

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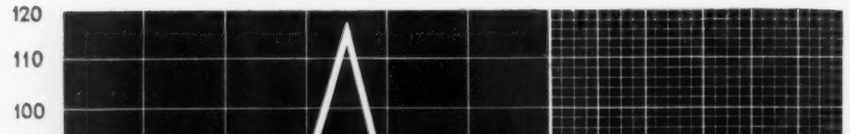
Stocks Gain Moderately



Public utility stock prices improved moderately during the past week, the "Electrical World" index advancing to 24.6, as compared with 24.2 for the previous week. Trading, however, was restricted.

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National Public Service Reports Revenue Increase

The National Public Service Corporation reports for 1931 net income of $3,703,948 after taxes, charges and depreciation, including $600,000 profit on sale of properties, equal, after preferred dividends, to $2.18 a share on 1,122,695 combined shares of A and B common stocks outstanding on December 31, 1931. This compares with $4,506,735 in 1930, when $1,039,362 profit was realized from sale of properties, equal to $2.96 a share on 1,122,024 combined A and B shares. The company is controlled by Middle West Utilities Company through National Electric Power.

Gross operating revenue was $36,449,923, against $33,126,350 for 1930, a gain of 10 per cent. Net earnings after depreciation were $13,922,797, compared with $11,892,185, and total income, including profit on sale of properties, was $15,785,481, against $13,331,004, a gain of 18.4 per cent. Surplus after all dividends was $378,958 against $1,244,561.

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Standard Power & Light Earns $2.68

The annual report of the Standard Power & Light Corporation for 1931 shows a balance of consolidated net income of $4,725,207 after preferred dividends equal to $2.68 a share on 1,760,000 common shares outstanding at the end of the year, comparing with $7,027,100, or $3.99 a share on the same number of shares in 1930. Consolidated gross earnings were $159,070,293, against $172,460,872, and net earnings were $74,031,461 against $76,111,098.

The consolidated balance sheet at December 31, 1931, shows total assets of $1,181,919,599, against $1,166,009,083 the year before. Current assets were $50,895,801, including $18,257,471 cash, and current liabilities were $37,367,082, including $6,584,542 notes payable. Surplus amounted to $45,484,936.

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Westinghouse Establishes New Lighting Unit

The Westinghouse Electric & Manufacturing Company has established an entirely new division of lighting specialists who will be located in all parts of the country and whose activities will be directed from headquarters in Cleveland.

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Current Earnings Reports of Electric Light and Power Companies

OPERATING COMPANIES

	1932	1931	Per Cent Increase	Operating Ratio 1932	Operating Ratio 1931
Detroit Edison (Year ended March 31)					
Gross earnings	$48,136,786	$52,146,433	— 7.7	65	67
Net earnings	16,688,419	16,797,994	— 0.7	..	..
Philadelphia Electric (Three mos. ended Mar. 31)					
Gross earnings	17,435,362	17,951,574	— 2.9	51	52
Net earnings	8,584,786	8,529,681	0.6	..	..
Louisville Gas & Electric (Year ended February 29)					
Gross earnings	10,397,687	10,607,993	— 2.0	46	48
Net earnings	5,629,622	5,546,692	1.5	..	..
Northern States Power (Year ended February 29)					
Gross earnings	33,890,289	33,302,796	1.8	48	50
Net earnings	17,548,455	16,622,970	2.0	..	..
Oklahoma Gas & Electric (Year ended February 29)					
Gross earnings	11,767,536	13,759,249	—14.5	50	53
Net earnings	5,967,588	6,413,756	— 7.0	..	..
San Diego Consolidated Gas & Electric (Year ended February 29)					
Gross earnings	7,602,236	7,425,918	2.4	48	49
Net earnings	3,904,546	3,785,646	3.1	..	..
Southern California Edison (Year ended March 31)					
Gross earnings	40,156,909	41,158,204	— 2.0	32	32
Net earnings	27,164,739	28,110,463	— 3.0	..	..
Wisconsin Public Service (Year ended February 29)					
Gross earnings	5,460,954	5,562,899	— 1.8	55	58
Net earnings	2,411,580	2,294,256	5.1	..	..
Kansas City Power & Light (Year ended March 31)					
Gross earnings	14,653,039	14,800,861	— 0.9	43	44
Net earnings	8,296,990	8,193,308	1.2	..	..

HOLDING COMPANIES

	1932	1931	Per Cent Increase	Operating Ratio 1932	Operating Ratio 1931
Commonwealth & Southern & subs. (Year ended March 31)					
Gross earnings	$127,356,099	$138,425,808	— 8.0	46	48
Net earnings	69,025,570	71,450,209	— 3.4	..	..
Federal Light & Traction & subs. (Year ended February 29)					
Gross earnings	7,994,273	8,375,705	— 4.6	57	57
Net earnings	3,468,776	3,604,486	— 3.8	..	..
Nevada-California Electric & subs. (Year ended March 31)					
Gross earnings	5,657,505	5,687,091	— 0.5	48	48
Net earnings	2,941,514	2,964,988	— 0.8	..	..
North American & subs. (Year ended March 31)					
Gross earnings*	115,781,217	127,395,506	— 9.1	53	51
Net earnings	54,647,119	60,318,943	— 9.4	..	..
Philadelphia Company (Year ended February 29)					
Gross earnings	54,261,183	60,808,256	—10.8	50	50
Net earnings	26,773,045	29,932,914	—10.5	..	..
Public Service Corporation of New Jersey & subs.† (Year ended March 31)					
Gross earnings	135,202,427	138,527,233	— 2.4	66	68
Net earnings	45,338,738	44,044,825	2.9	..	..
Standard Gas & Electric & subs. (Year ended February 29)					
Gross earnings	143,030,299	152,374,089	— 6.1	50	52
Net earnings	70,621,385	73,184,012	— 3.5	..	..

* Excludes gross earnings, operating expenses, etc., of former California subsidiaries for entire year ended March 31, 1932, and for 9 months and 18 days ended March 31, 1931.

† Operating expenses include depreciation.

Electric Bond & Share Explains Its Employee Stock Plan

WORLDLY-WISE Wall Street, ever on the watch for straws betraying the most fitful zephyr, has sought to interpret a recent publication entitled "Why a Sound Plan Failed and Was Repealed" as but another link in a chain of supposed evidence which indicates a major change in policy on the part of the Electric Bond & Share Company. The pamphlet referred to constitutes a report by six directors of that company explaining why in 1929 they recommended the sale of stock of that organization to officers and employees at a "depression-proof" price, below market levels, and why in 1931, when market prices had calamitously fallen, they advised cancellation of the plan, the money paid in to be refunded with interest.

Criticism of the plan was voiced at stockholders' meetings on December 7, 1931, and March 22, 1932. The pamphlet sponsored by Bond & Share directors is but one of the broadsides directed to stockholders of that organization. Max Goldberg of Salem, Mass., has also circularized the stockholders calling for a special meeting with promises of startling facts concerning: "(a) what sales of stock were made by the officers and directors in the last six months; (b) to what extent the officers and directors are holders of stock of the company today; (c) what salaries and bonuses are paid to officers of the company; (d) what increases of salaries and bonuses were made in 1931; (e) an analysis of what is shown as income and assets in the annual report; (f) how the asset columns in the annual reports were written up and written down; (g)the inside story of how the officers got large blocks of stock for $40 a share when shares were selling about $125 and then got their money back when the price fell."

"Why a Sound Plan Failed and Was Repealed" states in part that the Electric Bond & Share has two principal assets—securities, representing an interest in properties, and men. The latter, it asserts, are experts whose experience covers every phase of the operation of power and light, gas and other utility properties. The pamphlet then continues:

How to keep this team of men intact and to insure their continued service to the company over a period of years was a subject of earnest discussion in the board of directors, particularly in the years 1927-29, when the public utility industry was expanding rapidly and profitable opportunities for trained men were being opened up in all directions. It was believed this desirable results could best be achieved by making it possible for these men to acquire a substantial stock interest in the company under conditions which would insure their best efforts for its success over an average period of their active service.

The signatories of the statement on their sole initiative, suggestion and vote, the report says, fixed the stock allotments to the chairman of the board and the president at 30,000 shares each. The total number of shares provided for allotment was 480,765, while about 480,000 were allotted to about 160 participants. To the then thirteen vice-presidents was allotted an aggregate of 153,500 shares. The statement continues:

Certain of the directors felt the price at which the new stock should be sold to the officers and other employees should be set at $30. But, following much discussion, this figure was fixed at $40. With the financial crisis in the autumn of 1931 an impossible situation arose. So long as the amount of stock dividends which could be sold for the participants was sufficient to provide the interest on their unpaid balances, it was no hardship to them to continue their participation. But when the dividends were no longer sufficient to do this the commitments became a source of acute concern and even distress.

The stockholders approved at a meeting on December 7, 1931, that the plan be canceled. The stock was canceled and the money paid in by the participants was returned with interest.

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National Public Service to Omit Dividends

The National Public Service Corporation, controlled by the National Electric Power Company, a subsidiary of the Middle West Utilities Company, has notified the Chicago Stock Exchange that its directors on May 26 will omit the regular quarterly dividends of 87½ cents a share on the $3.50 preferred stock and 40 cents a share each on the class A and B common stocks, normally payable in June.

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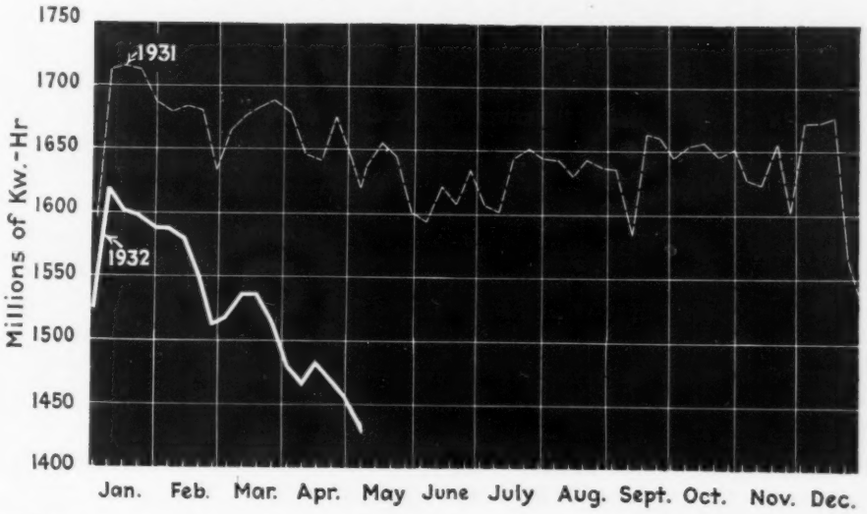
May Brings Decreased Output



THE first full week of May brought a decrease of 26,000,000 kw.-hr. in electrical energy output compared with the preceding week. Last year the drop was less pronounced; the result is a loss of 12.7 per cent from 1931, against 9.8 per cent the week before, and a similar though somewhat smaller decline when comparison is made with the corresponding averages for the past four years. The change cannot be ascribed to the setting ahead of our clocks, the first week in May having been on daylight-saving time in other years also.

Comparison regionally with 1931 shows conditions on the Atlantic Seaboard to be about the same, relatively, as in the recent past, with a moderate decrease in New England. In the Central and Western areas, there was a return to the level of two weeks ago.

Weekly Output, Millions of Kw.-Hr.

	1932	1931	1930	1929
May 7	1,429	1,637	1,689	1,698
April 30	1,455	1,644	1,698	1,688
April 23	1,470	1,676	1,725	1,700
April 16	1,481	1,641	1,733	1,709
April 9	1,465	1,647	1,715	1,697

Per Cent Change from 1931

	Week Ended		
Region	May 7	April 30	April 23
Atlantic Seaboard	— 8.9	— 8.5	— 8.9
New England alone	—11.8	—10.9	— 9.4
Central industrial	—16.3	—15.8	—17.3
Chicago district	—14.4	—10.6	—14.8
Pacific Coast	—12.0	— 9.1	—11.8
United States	—12.7	—11.5	—12.3

United Light & Power Assets Increase

Net income of the United Light & Power Company for 1931 was $7,819,382 after taxes, charges, depreciation, subsidiary dividends and minority interest, equal, after preferred dividends, to $1.21 a share on 3,473,919 average number of common shares outstanding during the year, against $10,462,450, or $2.01 a share on 3,424,193 average number of common shares in 1930.

Gross operating earnings of subsidiary and controlled companies after intercompany transfers were $83,206,657, against $88,393,702, a decline of $5,187,045. Expenses were reduced $2,584,777, maintenance was reduced $880,836, taxes were $385,357 lower and depreciation $226,427 higher, making net earnings $26,728,337, a decline of $1,562,502 from 1930. Total assets at December 31, 1931, were $575,643,694, against $573,646,485, the year before.

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Commonwealth & Southern Cuts Operating Costs

Gross earnings of the Commonwealth & Southern Corporation in 1931, including other income, amounted to $130,116,633, as compared with $141,656,530 in 1930, a decrease of 8.15 per cent, and operating expenses, before taxes, decreased $7,311,150, or 13.30 per cent, as compared with 1930. After deduction of operating expenses, taxes, interest and other charges, including dividends on preferred stocks of subsidiary companies and provision for retirement reserve, the balance was $22,369,531, which is equivalent to $14.91 per share on the outstanding preferred stock, as compared with $19.15 per share in 1930. After preferred dividend requirements, the balance for the year was $13,374,115, or approximately 40 cents per share on the common stock outstanding on December 31, as compared with 60 cents per share for the previous year.

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Northern States Power Earnings Up

The annual report of the Northern States Power Company for the year ended December 31, 1931, shows an increase in gross earnings of $711,047, or 2.13 per cent, and an increase in net earnings of $1,009,582, or 6.07 per cent, compared with the previous twelve months. Balance for amortization of debt discount and expense, common dividends and surplus came to $4,136,642 in 1931, as compared with $3,916,823 in 1930.

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Pacific Gas Improves Capital Set-up in 1931

The year 1931 continued the unbroken upward tendency of gross revenues which has characterized the Pacific Gas & Electric Company's operations since its incorporation 26 years ago. The year's total gross of $87,630,661 exceeded by $1,997,520 that of all companies included in the present consolidated system for the full year 1930. Of the total operating revenues from all sources $66,123,241, or 75.46 per cent, was derived from the sale of electricity. Net operating income, after the deduction of all operating expenses, maintenance, taxes and reserves, except depreciation reserve, amounted to $50,117,816, an increase of $2,039,615. After the addition of $906,185 of non-operating revenues, arising from interest on bank balances, income from investments, profit on appliance sales and other miscellaneous items, the total gross income available for depreciation and a return to the company's security holders was $51,024,001, or $2,075,685 more than in 1930.

The surplus available for the payment of dividends, after the deduction of all prior charges, amounted to $24,791,382. Preferred dividends aggregated $7,803,316, leaving for the common a balance of $16,988,066, equivalent to $2.73 per share on the 6,232,264 shares in the hands of the public at the close of the year.

At the close of 1931 the total par value of all securities of the company and its subsidiary and affiliated corporations held by the public aggregated $598,390,816. Of this amount bonds represented $308,755,400, or 51.6 per cent, the ratio of mortgage debt to total capitalization being the smallest in the history of the company. Preferred stocks represent 22.3 per cent and common stock 26.1 per cent of all outstanding securities. The proportion of total capitalization represented by these various classes of issues indicates the conservatism of the capital structure,

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Exports of Electrical Equipment (Preliminary)

Article	March 1931	March 1932
Generators:		
Direct current	$111,731	$7,034
Alternating current	12,905	373,664
Steam turbine generator sets	51,361	182
Accessories and parts for generators	49,452	106,687
Arc welding sets	60,430	11,998
Self-contained lighting outfits	19,779	7,011
Batteries	502,090	374,262
Transforming or converting apparatus:		
Power transformers over 500 kva	52,242	151,128
Distribution transformers, 500 kva. and less	93,980	32,340
Instrument transformers	13,267	6,685
Other transformers	44,920	25,189
Complete battery chargers, non-rotating	9,198	2,587
Double-current and motor generators, dynamotors, synchronous and other converters	121,172	41,123
Transmission and distribution apparatus:		
Switchboards, circuit breakers over 10 amp. and fuses	427,774	249,466
Watt-hour and other measuring meters	72,321	21,899
Indicating and recording instruments	76,176	52,278
Other electrical testing apparatus	59,945	59,312
Lightning arresters, choke coils, reactors and parts	64,853	31,781
Motors, starters, and controllers:		
Fractional hp. motors	$150,367	$62,369
Stationary motors	156,938	40,181
Railway motors	3,800	17,812
Electric locomotives	40,140	19,978
Electric motor trucks	25,313	.....
Starting and controlling equipment	113,492	60,419
Portable electric tools	52,877	19,076
Accessories and parts for motors	106,240	68,789
Electric refrigerators and parts:		
Household	801,178	318,417
Commercial up to 1 ton	224,661	206,212
Parts for electric refrigerators	331,410	275,293
Electric appliances:		
Flashlight cases	45,907	17,071
Electric fans	44,446	24,265
Electromechanical health exercisers	5,293	335
Electric incandescent bulbs	77,686	59,044
Searchlights and floodlights	15,479	6,881
Electric household washing machines	80,319	25,491
Electric domestic vacuum cleaners	99,977	34,254
Other domestic motor-driven devices except tools	48,828	15,327
Electric flatirons	19,544	8,282
Electric cooking ranges	37,008	5,388
Other domestic heating and cooking devices	82,215	21,418
Industrial electric furnaces, ovens and other heating devices	35,520	24,719
Therapeutic and X-ray apparatus	$95,590	$45,247
Signal and communication devices:		
Radio apparatus	1,546,635	1,096,576
Telegraph apparatus	39,555	13,674
Telephone apparatus	247,346	69,643
Bells, buzzers, annunciators and alarms	55,767	16,095
Other electric apparatus:		
Starting, lighting, and ignition equipment	36,739	60,032
Insulating material	55,099	52,389
Miscellaneous wiring supplies	1,028,531	447,057
Electrical porcelain	101,085	28,222
Carbons and electrodes:		
Electrodes for electric furnaces	106,595	64,851
Other carbon products	45,089	.....
Carbon brushes and stock	.....	15,347
Other carbon products	.....	28,681
Insulated iron or steel wire and cable	10,492	8,807
Copper, bare wire	87,637	16,950
Insulated copper wire and cable:		
Rubber-covered wire	44,718	41,752
Weatherproof wire	46,180	23,548
Telephone cable	6,153	15,245
Other insulated copper wire	171,856	30,025
Nickel-chrome electric resistance wire	10,123	21,400
Electric clocks	.....	9,712
Totals	$8,177,415	$4,990,900
Three months ended March 31	$23,097,880	$13,807,489

enabling the company to secure additional capital funds which may be required for future expansion from the sale of either bonds, preferred stock or common stock, as the judgment of the management and the condition of the financial market may indicate to be most advantageous.

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Receivership Sought for Federal Public Service

Receivership proceedings were instituted in Chancery Court, Wilmington, Del., and United States District Court, Chicago, on Tuesday against the Federal Public Service Corporation, which provides 311 communities in seventeen Middle Western and Southern states with electric, gas, water and telephone services.

The organization was incorporated in Delaware as a holding company April 26, 1927, and, according to the bill, owns and controls 95 per cent of the stock of more than 35 subsidiary utility companies.

All the common stock of the corporation is owned by the Union Power Corporation of Chicago. The corporation has outstanding in the hands of the public preferred stock with a par value of $3,545,000 and funded debts of $18,887,900, of which $7,000,000 in 6 per cent notes falls due July 1. The complainant alleges that the corporation will be unable to meet this maturity.

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Little Change in Utility Operations

Electric light and power company revenues for March thus far reported average 3.9 per cent lower than in 1931, thus making the same relative showing as in February and a somewhat better one than in January, when they were down 4.5 per cent. On this basis the total for the industry is estimated at $168,900,000, compared with $175,840,000 a year ago. January revenue was $188,010,000; February $175,110,000.

The decrease of 3.5 per cent from the preceding month is in line with the established seasonal change but somewhat smaller than usual, the average for the past five years being 4.5 per cent.

Output statistics for public utilities during March, as announced by the United States Geological Survey, indicate a decrease of 7 per cent compared with 1931, against a decrease of 6 per cent in average daily output in February and 5 per cent in January. The difference in total during February was only 3 per cent, but the month had an extra day in 1932.

Comparative figures on output are as follows:

Month	Kilowatt-Hours (Millions) 1931	1932	Per Cent Change 1931-2	1930-1	Produced by Water Power, Per Cent 1931	1932
January	7,956	7,543	—5	—8	30	41
February	7,170	6,997	—6*	—6	30	42
March	7,888	7,321	—7	—4	34	43

*Based on average daily production.

The average daily production of energy for public use in March was about 2 per cent less than in February, as was also the production from water power. Actual kilowatt-hours of the latter were, in February 2,972,000,000, in March 3,118,000,000.

Percentage changes in output from the previous year by regions for the two months are given in the following table:

Region	February	March
New England	—4	—10
Middle Atlantic	—2	—3
East North Central	—7	—11
West North Central	+6	0
South Atlantic	+10	—4
East South Central	—8	—12
West South Central	—4	—10
Mountain	—12	—19
Pacific	—5	—8
United States	—3	—7

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British Electrical Imports Decline Heavily

In the domestic market British firms are now reaping the benefits of duties on foreign imports and the depreciation of the sterling exchange. In many branches of the trade foreign imports have fallen to negligible figures, leaving the market virtually in the hands of some home producers. The following figures of battery imports are typical of the change which is taking place:

	Foreign Imports— 1932	1931
January	£8,600	£36,000
February	£11,800	£39,800
March	£6,500	£36,700
Three months	£26,900	£112,500

In the first quarter of 1932 imports of batteries from abroad have fallen by nearly 80 per cent. Imports of electrical goods and apparatus as a whole have declined by roughly 50 per cent during the same period. German and Swiss manufacturers, who sell their goods on a gold basis, have been hardest hit by this sharp contraction in sales in the British market. In many branches German importations have practically disappeared, leaving Danish imports as the only competitive foreign goods.

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British Increase Electrical Duties

Additional British import duties, recommended by the tariff advisory committee, have just been announced as taking effect April 26. They include a 10 per cent duty on the following electrical goods: Insulated electric wires and cables, telephone, telegraph and radio apparatus, electric carbons, electric lighting appliances and fittings (other than glass bulbs for electric filament lamps), batteries and accumulators, electric bell apparatus, electric cooking and heating apparatus, electric meters, parts and accessories.

Major New Construction This Week

CONSTRUCTION of a 220-kv. double-circuit steel tower transmission line, 5¾ miles long, is asked for in bids closing May 18 by Board of Public Works, Seattle, Wash.; also for completion of Diablo unit of Skagit River municipal power development, including power house superstructure, tailrace, installation of prime movers previously purchased, furnishing and installing switchboards, etc. A $1,500,000 project.

South Dorchester Electric Light & Power Company, Baltimore Trust Building, Baltimore, Md., recently organized, will construct and operate an electric power plant at Hooper's Island, Dorchester County, and construct transmission line. Estimated $100,000.

Machine drives, motors and controls, panelboards and instruments, conveying machinery and other electrical equipment will be installed in $100,000 mill at Bellingham, Wash., by Consolidated Furniture Company, Portland, Ore.

Lincoln, Neb., asks bids until June 1 for electrical equipment for a municipal pumping plant, including 4,000-kw. turbo-generator unit and two-panel switchboard, circulating and condensate pumps and accessories. Estimated $120,000.

Power plant machinery, electric power and control system and complete electric lock-operating machinery for dam at lock and dam No. 15, Mississippi River, are asked for in bids by United States Engineer Office, Rock Island, Ill.

Electric power equipment, including ore crushing and refining machinery, motors, controls, panelboards, conveying and other equipment, estimated at $50,000 for proposed ore-treating mill of Colorado Gold Refineries, Inc., Denver, Colo.

Bureau of Supplies and Accounts, Navy Department, Washington, D. C., is asking bids until May 17 for 200,000 ft. of high-tension cable for Philadelphia Navy Yard (Schedule 7993).

Electric ice-making equipment, power plant equipment and accessories will be installed in Culpeper, Va., power station and ice plant of Virginia Public Service Company, Charlottesville, Va., to replace $100,000 fire-damaged equipment.

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New York Metal Prices

	May 4, 1932 Cents per Pound	May 11, 1932 Cents per Pound
Copper, electrolytic	5.75	5.50
Lead, Am. S. & R. price	3.00	3.00
Antimony	5.30	5.25
Nickel, ingot	35.00	35.00
Zinc, spots	2.90	2.75
Tin, Straits	22.25	21.33
Aluminum, 99 per cent	23.30	23.30

No Immediate Rate Cut in Detroit

A long fight over rate reductions demanded by Mayor Frank Murphy on behalf of the city of Detroit is prophesied. Opening arguments before the Michigan Public Utilities Commission were held last week and the case was adjourned until June. James V. Oxtoby, attorney for the Detroit Edison Company, is quoted as saying that conditions do not permit a reduction in rates at this time, but that the company will follow its 30-year custom by making one voluntarily as soon as this becomes possible.

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Camden Joins Rate-Protest Cities

By unanimous vote the Camden (N. J.) City Commission has called upon the Public Service Electric & Gas Company to make a voluntary reduction in electric and gas rates for domestic consumers. The commission says that if this is not done it will call upon the Board of Public Utility Commissioners to investigate the entire rate structure of New Jersey. The resolution adopted declares that gas and electric rates are 40 per cent lower for comparable service in Philadelphia and that large users are favored at the expense of small ones.

▼

District Commission Seeks Light

In an effort to expedite valuation proceedings, the Public Utilities Commission of the District of Columbia recently petitioned the Supreme Court of the District asking for no less than 57 separate instructions on controversial points. If the court will set the rules, the commission announces, it will follow them, thus, it hopes, reducing litigation to a minimum.

▼

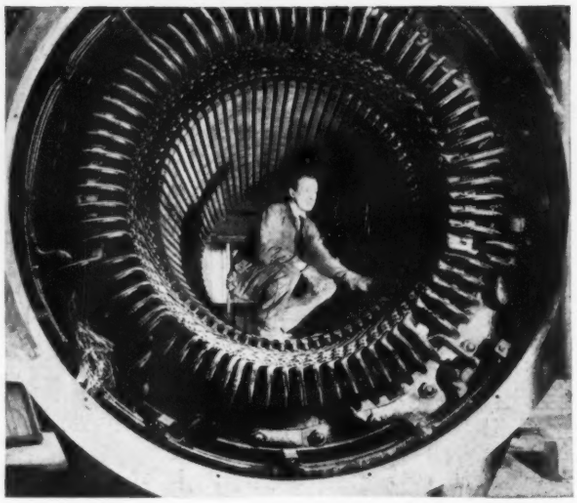
Application of Gross Receipts Tax

By a decision of the Dauphin County Court the Philadelphia Electric Company must pay the 8-mill state revenue tax on gross receipts from electric appliances as well as on receipts from sales of energy, thus increasing its tax for a thirteen-month period by $55,116. The court held that the tax is not applicable to revenue from sources other than those connected with the use of electricity, but ruled that appliances designed to be operated by electricity are so connected.

▼

Copper Duty Forced Into Tax Bill

Together with duties on several other commodities, a duty of 4 cents a pound on imported copper was forced into the tax bill by a majority vote of the finance committee of the Senate last week. This was done on the insistence of American copper producers. A fight to throw out all protectionist clauses is likely before the tax bill gets through Congress.



BATTERSEA'S BIG MACHINE GETS THE FINISHING TOUCH

Englishmen are proud of the 80,000-kw. turbo-generator soon to begin operation at Battersea, in London, and said to be largest of its kind in Europe.

—Keystone View Co.

▼

Camp Co-operation XII in August

August 3 to 8 has been fixed as the time for the annual assemblage of electrical league delegates heretofore held at Association Island in the St. Lawrence. It is the intention this year to hold the convention on a steamship, making a round trip from New York to Bermuda. Reservations will be received by the Society for Electrical Development until June 20.

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Alderman Hode Asks Suggestions

Alderman Barnet Hode of Chicago, chairman of a City Council subcommittee appointed to aid in developing a program of improved utility control for that city and Illinois generally, has written to more than fifty men in twelve states asking suggestions and advice. Governors Pinchot of Pennsylvania and LaFollette of Wisconsin and Profs. W. Z. Ripley of Harvard and J. C. Bonbright of Columbia are included.

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City Plant for St. Charles, Mo.?

Consulting engineers of St. Louis, have reported to the City Council of St. Charles, Mo., that a municipal light and power plant for that community could be built from the proceeds of a bond issue for $300,000 and that the plant would pay for itself out of profits within five years. The present franchise of the Union Electric Light & Power Company in St. Charles does not expire until 1933. The engineers' estimate of profits is based on the assumption that the present rates could be maintained and that the Union Electric Light & Power Company would compete with the city-owned plant for about four years.

Bids for Oregon State Power Plant

The State Board of Control of Oregon has called for bids to be opened May 12 for a 740-kw. Diesel power plant at Salem, Ore., to serve the Capitol, state office buildings, supreme court, hospital, penitentiary and other state institutions in and around Salem now served by the Portland General Electric Company. This action is the outcome of the appointment of a committee by the last Legislature to look into the feasibility of serving the state institutions by a state-owned power plant. On this committee are engineers associated with municipal systems and a state senator.

▼

Condemning Property in Public Use

Whether taxpaying property already devoted to public use by a utility company can be condemned by a municipality is the question awaiting adjudication by the Superior Court of Los Angeles County in two actions brought against the Southern California Edison Company by the Los Angeles Department of Water and Power. The city seeks to condemn power lines and equipment belonging to the company in twelve districts annexed by Los Angeles since the sale of the company's lines in 1922. The company is opposing the suit on principle, although less than 2 per cent of its revenue is involved.

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New River Hearings Continued

When the suit of the Appalachian Electric Power Company to force the Federal Power Commission to grant it a minor-part instead of a major-part license was reached in the United States District Court at Norfolk, Va., last week, Judge Luther B. Day continued hearings, postponing decision on motions of the company to amend its complaint and of the commission to amend its answer. Arguments on the navigability of the

river and the jurisdiction of the commission over the company's pre-license costs and accounting methods will be heard at a later date, when a motion to dismiss the case will be presented.

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Athabasca's Vast Potential Output

Recent surveys of the hydro-electric possibilities of the Athabasca River in the Province of Alberta, Canada, reveal enormous potential power. From its confluence with the Whirlpool River at an elevation of 4,000 ft. to Lake Athabasca, a distance of 820 miles, the Athabasca falls approximately 3,300 ft. Using only 800 ft., engineers estimate that 810,000 hp. could be developed. With the high load factor of 60 per cent, this would require the installation of 1,170,000 hp., and by using another 800 ft. of the available fall there would be in the course of time well over 2,000,000 hp. available from the Athabasca.

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Mount Vernon Highway Is Brilliantly Lighted

Extending for 15 miles from the tomb of the "Unknown Soldier" through Alexandria, Va., to the Washington homestead, the Mount Vernon Memorial Highway was opened to traffic on March 24, but the work of installing the special lighting fixtures to provide suitable illumination has only recently been completed.

For the illumination on the 60-ft. highway to Alexandria, General Electric form 32 "Novalux" lighting units are employed, with B-symmetric dome refractors and 6,000-lumen lamps. Union Metal fluted poles, 150 ft. apart in staggered formation, support the fixtures at a mounting height of 20 ft. All wiring is underground. From Alexandria to Mount Vernon, where the roadway is 40 ft. wide, type 25D "Novalux" luminaires with 11-in. rippled-bowl refractors and 6,000-lumen lamps are used, and a mounting height of 17 ft. is employed.

▼

Telephone Co-operation in Avoiding Radio Trouble

Notice has been given by the American Telephone & Telegraph Company that the operating telephone companies of the Bell system will be glad to co-operate with radio dealers and repairmen in any case in which interference with radio reception appears to be caused by induced currents from these sources, if the radio dealer will get in touch with the nearest business office of the Bell Telephone Company. This announcement may serve to clear light and power companies in some cases where interference with radio reception is wrongfully attributed to energy service lines.

The American Telephone & Telegraph Company does not deny that under some conditions the operation of certain parts of the telephone system, including dial, ringing generators and relays, produces high-frequency currents within the radio broadcast frequency range. "With some conditions of proximity between the telephone wiring and the antenna or power wiring of the radio set," it says, "and depending also upon the condition of susceptibility of the radio set to outside noises, dialing or other operations over the neighbors' telephone lines may be accompanied by objectionable noises in the radio receiving set."

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Electric Water Heaters Installed Free of Charge

Trial installation of electric water heaters was one of the inducements offered to customer-visitors at the Southend Electrical Exhibition, held at Southend-on-Sea, England, last month. The Southend Corporation offered a three months' free trial, at the end of which period the consumer will be given the opportunity to purchase the heater on the time-payment plan.

The scheme was enthusiastically received. Applications far exceded the 100 units included in the offer. Energy is supplied for this service at one cent a kilowatt-hour by the corporation. An unmetered rate is available at $5 a quarter. Favorable time-payment features are offered, including quarterly installments on a seven-year purchase contract.

Prices include all plumbing and wiring and free maintenance of heating elements. A 30-gal. unit may be regularly secured, for example, for a down-payment of $25 and quarterly payments of about $5.

Other features of the Southend Corporation's policy are of interest: All electrical equipment for domestic use is available on easy time-payment plans; an assisted wiring scheme is included which insures adequacy and low cost for new jobs; low rates encourage use. Some twenty manufacturers, two national associations and fourteen local contractors were represented at the exhibition, and attendance averaged more than 3,700 visitors a day.

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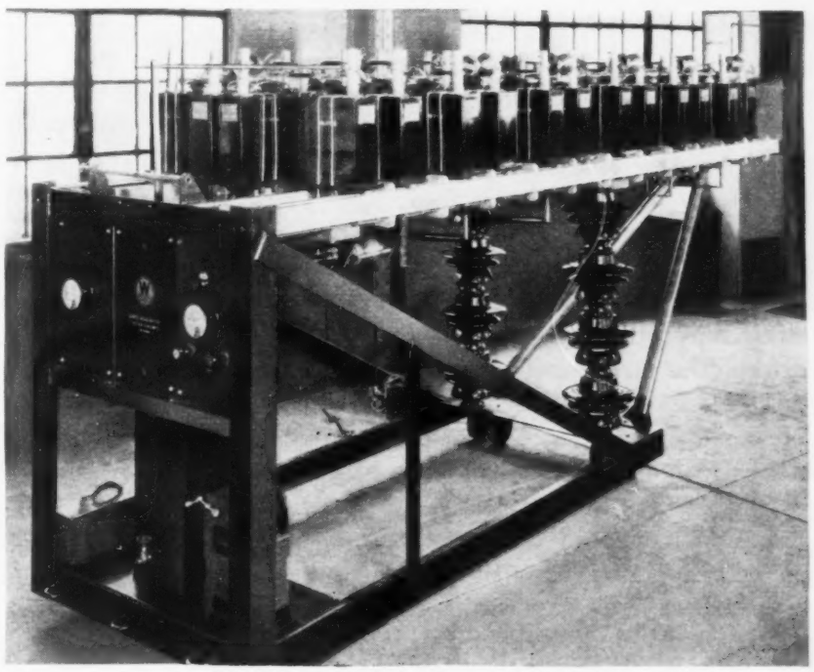
Surge Generator to Aid Insulation Co-ordination



The Duquesne Light Company of Pittsburgh is said to be the first utility to purchase a lightning-generator and cathode-ray oscillograph equipment as an everyday tool for system study. In addition to the short, steep waves for surge tests, long waves from the set can often be substituted for "60-cycle tests" of insulators, usually done with transformers.

The portable 750-kv., 4,000-watt-second Westinghouse surge set consists of twelve sets of condensers (0.0145 mfd.) charged in parallel by a 70-kv. tube rectifier, in oil-filled tank, and discharged in series. Weighing 3 tons, it stands 8 ft. high, 4 ft. wide and 17 ft. long, with a wheel base of 10 ft. The cathode-ray oscillograph is not shown in the accompanying illustration.

EDITORIALS

L.W.W.MORROW
Editor

Gadsden presents a program

COMMONLY heard in discussions of utility regulatory practice is the sentiment that the commissions should be rendered strong, courageous and comprehensively effective. Not always have utility people indicated how this shall be accomplished. Recently, however, one of their executives, Philip H. Gadsden, has outlined several specific moves which will strengthen regulation and at the same time should go far to make independent regulation of the utility holding company utterly unnecessary.

Four distinct suggestions are made. At the outset he says that all information which would have a bearing on the quality and cost of service to the industry's customers should be given freely to the commissions. That is no more than what must have been contemplated when commissions were set up to regulate fair rates for good service. Next, the commissions should be let in on the contractual details between holding companies and their subsidiaries and even approve or disapprove of these arrangements. Anything less than that is bound to be looked upon as evasion and circumvention of society's determination to exact equities in return for the grant of a monopoly. Third, Mr. Gadsden pleads for an agreement upon fundamental principles of valuation which will command the allegiance of both investors and the public. Certainly, nothing could be worse than for both sides to flop ungracefully from reproduction cost to prudent investment and back again as fast and as frequently as a flickering dollar leaves them on the opposite side of the fence. Finally, he urges adoption of a code of ethics for utility management which will command such respect as to make the enterprise less a trade and more a profession.

Coming from such a student of regulation within the industry, the outline immediately acquires positiveness and merit. No external critic has framed anything half so specific, half so comprehensive or half so close to common sense. Frankly put, the proposals reflect sincerity and a conscientious recognition of public duty. Those who are disposed to quibble and split hairs on the details of accomplishing such a desirable end will find themselves pitted against public sentiment.

What the figures show

DETAILED figures on capacity and energy were published in the ELECTRICAL WORLD last week for 142 utilities, composing over 90 per cent of the industry. Some striking deductions may be made by comparing 1931 data with those of 1929. For example, energy sales changed as follows: Domestic increased 28.2 per cent, retail commercial increased 4.5 per cent, wholesale commercial decreased 14.6 per cent, and sales to municipal properties increased 1.5 per cent. In 1929 wholesale sales were 44 per cent of total sales, and in 1931 the proportion had decreased to 37.6 per cent. These data show the remarkable increase in domestic sales and are supported by the 23 per cent increase in the average use of energy per domestic customer.

Statements have been made that the industry is vastly overbuilt in generating-plant capacity. As a matter of fact, the plant factor was 35.9 in 1929 and 30.3 in 1931, according to these data, despite the abnormal decrease in the production and sale of wholesale power and despite an actual addition of capacity of 4,000,492 kw. in the two-year period. This is a remarkable showing and indicates that a normal return of industrial power business would find capacity to carry it lacking. In this connection also it should be remembered that it takes from one to two years to build a steam generating station. The industry is not overbuilt in generating plants.

Brockton challenges pessimists

TO SELL more than 1,500 major household appliances in the face of such difficult times as 1931 brought to Brockton, Mass., is an outstanding achievement for the local electrical industry. Total appliance sales last year averaged $23.34 per residential customer of the Brockton Edison company, of whom there are some 25,600 on the system. How this was done was told in the issue of April 30, but in a word it was accomplished by co-operation between all branches of the industry, carefully planned sales efforts, prices and rates which appealed to the householder as reasonable, and by capitalizing on the good will built up by the district representative system of the utility over a period of about four years. Every constructive piece of work done brought profit to the branch of the industry contributing it, and the local good feeling underlying the accomplishment is well indicated by letters from representative retailers. The Stone & Webster organization and the Brockton company deserve congratulation for leadership in bringing about the fine results described, and the local branches of the industry likewise should receive commendation for their effective participation.

The Brockton territory typifies much that is best in everyday American life. It is neither the home of widely distributed wealth nor of widespread poverty. Shoe manufacturing is the leading industry. In the outlying communities as well as in the central city will be found a broad range of circumstances among residents. Such a representative cross-section of the industrial East offers valuable proof of what can be done elsewhere with suitable methods in popularizing the use of major electrical appliances in the home. It is significant that one of every two employees of the Brockton company is the user of an electrical refrigerator and that two employees out of five cook electrically. Preaching is evidently practiced here. Seventy-nine kilowatt-hours per residential customer were added to the territorial consumption in 1931 by appliance sales. Even with 3,000 refrigerators in use at Brockton, 88 per cent of the home customers remain to be convinced and 94 per cent of the residential users have still to enjoy the benefits of electric cooking. With such an unsaturated market it is permissible to anticipate further sales accomplishments over a period of years.

If Brockton can do so much in adverse times, should not many other places take courage and fall into line? Here was no miracle, but hard work and good relations with trade and public. The record is a ringing challenge to the downcast and the hesitant.

Muscle Shoals bill passed by House

MUSCLE SHOALS is still with us, but the passage of the new bill by the House at least advances the prospects for its acceptance by the Senate. Since public sentiment would not permit outright sale of the property, the alternative was to lease it or to operate it as a government enterprise. The new bill makes a very fair approach to the solution of the problem by three main provisions: (1) An endeavor will be made to lease the property other than power facilities within eighteen months; (2) in the event that no lease is made the government will enter the fertilizer business; (3) if in the future any private corporation wishes to lease the property, the lease shall be made and governmental operations shall cease.

Control of power facilities and power production is to be retained by the board of three men to be appointed by the President. Power shall first be allocated to fertilizer production, next to counties, states and municipalities, and last to utilities. The Cove Creek Dam is to be constructed when additional power is needed for fertilizer manufacture. All power is to be sold at the switchboard of the plants.

Strict stipulations are made for fertilizer production. Profit is limited to 8 per cent, and 10,000 tons of fixed nitrogen and 15,000 tons of phosphoric acid must be produced in about two years, increment increases being specified. Provision is made, however, for the production of other chemicals as part of the manufacturing enterprise.

This bill is a final attempt to dispose of Muscle Shoals in a way that will be acceptable to Congress and to the President. It may or may not be perfect, but it is a workable attempt and should be tried out. Muscle Shoals has been a football long enough, and a sigh of relief will be heard from everybody if it can be put out of politics and into production.

Columbia River power visions

ACCORDING to General Lytle Brown, Chief of Engineers, it is possible to develop 8,000,000 kw. of hydro-electric power at nine sites on the Columbia River at a total cost of about $772,000,000. He also says that the development of Grand Coulee alone would meet any probable increase in power needs of the accessible area for the next thirty years. This is the latest official report on the Columbia. It follows the opinion of Secretary Hyde that developments should not be made now despite the recommendation of Elwood Mead of the Bureau of Reclamation that a large project in power, irrigation, navigation and flood control be undertaken.

It is true that enormous resources in hydro power are available in the Columbia River and that the Columbia Basin covering about 1,100,000 acres could be irrigated, but any suggestion that these projects be undertaken in the near future is unsound. There is no load to absorb the power, and there is little prospect of load in an area where markets are limited, labor is scarce and unskilled, taxes are high and raw materials are distant. Nor is there a market for land at about $175 per acre for irrigation when agriculture is already suffering from overproduction and vast areas of land that do not require irrigation are available for farming.

Columbia River power is a resource to be utilized in the distant future. There is no economic or social reason for the agitation to have the government undertake this project at this time.

Capitalizing progress

IN TELLING the New England Gas Association recently that the electrical industry has developed no little business by making the public what might be called "progress-conscious," Samuel Insull, Jr., commended a policy which can be applied advantageously to both industries for many years to come. Reiteration of the point that the present era is an electrical age has had an immeasurable influence upon sales of energy and growth of acceptance of appliances and apparatus by the public.

Self-satisfaction on the part of the electrical industry, however, is out of place in view of the existing moderate saturation of the market as compared with future possibilities. Mr. Insull pointed out that while the total volume of electrical sales increased 100 per cent from 1920 to 1930 as against 25 per cent gain in the gas industry, the kilowatt-hours generated per customer actually decreased 3.5 per cent against a gain in gas sales per customer of 4.7 per cent. The two industries—"corporate Siamese twins," as Mr. Insull called them—have many similar problems. The invention of the incandescent lamp brought about a sort of moral collapse in the gas industry 50 years ago, but new outlets were developed and both industries have added new strings to their bows as their services have evolved. The competition of progress is wholesome both as a stimulus to research and as an aid to creating business.

Suggestion for subornation

Between the dark and the daylight,
When far from expensive is power,
Comes a pause in the day's occupation
That is known as the kilowatt-hour.

THIS liberty with Longfellow was taken by "F.P.A." in his New York *Herald-Tribune* column. The significance of the parody does not lie in the touching picture of the little kilowatt-hours clustering on the parental knee begging to be told a story, but in the second line, "When far from expensive is power." Mr. Adams' tongue was deep in his cheek when he wrote this line, but if every word he ever has uttered and ever will utter before he dies contains as much truth as these six, then his account on the books of the recording angel will have no entries under the heading of "lies."

Electric power is not expensive. It is cheap. Sincere efforts are being made by utility men to make it cheaper. To say or to infer that electric power is being made less expensive is to give a wrong color to the matter. The sense of "far from expensive" is exactly correct "between the dark and the daylight" and at all times of the day and night. If it could be done without inspiring the charge that the "power trust" was now suborning the newspaper columnists after having bribed all the college professors, it might be a good idea for the electric utilities to induce other minnesingers to smite their lyres to the tune set by Mr. Adams.

George Madill Gadsby

STILL young in years as well as appearance, George M. Gadsby, president of the Utah Power & Light Company, has behind him 22 years of executive experience in public utility work, his first "job" in such a capacity having been as superintendent of the Warren (Pa.) Water Company after a year's work as a chemist for the same subsidiary of the American Water Works & Guarantee Company, now the American Water Works & Electric. With the parent company he remained, with a brief interruption, for nineteen years, being transferred to Pittsburgh in 1911, to Little Rock, Ark., as superintendent of the Arkansaw Water Company, in 1913; to New York in 1915, and finding himself back in Pittsburgh in 1917 as assistant to the late A. M. Lynn, then president of the West Penn companies. In 1918 Mr. Gadsby was promoted to be a vice-president of the West Penn Power Company, and on April 4, 1927, he became its president.

At the beginning of 1929 Mr. Gadsby left Pittsburgh to associate himself with the Electric Bond & Share Company of New York and was made president and general manager of its Utah subsidiary, with headquarters at Salt Lake City. He thus has had the unusual experience of directing two large operating companies in widely separated territory—a success ascribed by one of his admirers to a combination of "grit and grin," involving "tolerance, determination, patience and 'stick-to-itiveness.'"

Born in Collinwood, Ohio, a suburb of Cleveland, in 1886, Mr. Gadsby was graduated from Marietta College in 1907 and received a B.S. degree from the Massachusetts Institute of Technology in 1909. The honorary degree of doctor of engineering was conferred on him by the University of Pittsburgh in 1928, the dean citing as one of the reasons for its award Mr. Gadsby's interest in the promotion and development of educational programs within and without his company. He has been an active worker in utility association affairs and while a resident of the Keystone State organized the Commercial Section of the Pennsylvania Electric Association and served as chairman for three years. In 1924 he was elected president of the association. He also acted for two years as chairman of a special power survey committee, representing the association in conferring with Governor Pinchot's "giant power" survey and in work done in conjunction therewith by the Public Service Commission of the state.

Four Suggestions for Removing Criticism

By PHILIP GADSDEN*
Vice-President United Gas Improvement Company

THE public utility industry is not immune from the general situation that affects industry. We face the same questioning as to our motives and practices; we are subjected to ill-considered legislation; we are taxed intolerably, and more and more taxes are proposed; we are investigated and berated; we are threatened with government and municipal ownership. But, in the face of all this, we must continue to supply the same high standard of service which we developed in less strenuous times.

The burden of criticism which our industry has borne has rested, not upon our service, but upon our rates and the effect upon them of regulation, valuation and the practices of the holding company system. The criticism primarily is whether present-day utility practices are in the public interest; the problem of bringing our policies into complete harmony with the public interest is one to which we need to devote intense study. It will not do to dismiss lightly the charges that utility practices result in unwarranted rates on the grounds that they emanate from politicians and some newspapers. The fact that they gain support from men in public life and from the press demands that they be considered seriously.

What is needed for a satisfactory solution of these perplexing questions is, first, that they be understood; second, that they be discussed from the standpoint of the economies involved, free from political, partisan and social bias; third, that they be settled on a basis which will promote, rather than hinder, the growth and expansion of the utility industry.

As a program to answer criticism and to insure a continued healthy development of the utility industry, I would suggest the following policy:

1. To strengthen the regulatory powers of all public service commissions to the end that they should have full information concerning all factors which enter into the quality and cost of service to our customers, and to establish commissions in states where such bodies do not now exist.

2. To give public service commissions full information regarding the contractual relations between holding companies and their subsidiaries.

3. To determine a principle for the valuation of public utility properties upon a basis which would command the support of both the public and the owners of the properties.

4. To continue our efforts to develop the code of ethics of public utility management to a point where the industry will cease to become a trade and will be classed as a profession.

Critics have repeatedly charged that commission regulation is a failure, that the industry, especially in the electric field, is being allowed to gouge the public with excessive rates. Many defenders of the utility industry have proved conclusively that this charge is entirely unwarranted. Commission regulation has not broken down and is not a failure.

The only thing, in my judgment, which would make the general acceptance of municipal ownership of utilities possible would be the actual, and not imaginary, breakdown of state regulation. The complete answer to municipal ownership agitation is effective, courageous, comprehensive regulation by public service commissions.

The wise policy on our part should be one that does not oppose any and all amendments to public service commission laws, but, to the contrary, should be one that supports those changes that will strengthen regulation. If the regulatory powers of state commissions should be strengthened as experience in the last 25 years would suggest, we may offset, to some extent, present criticism of such regulation and the agitation for federal regulation or municipal ownership.

Our critics infer that holding companies drain off the profits of operating companies, and that if this were eliminated, rates could be lowered. Here, again, confusion exists in the public mind and we must do some straight thinking on this problem. The holding company appears in all fields of business and it is accepted as an established agency in American finance.

I am sure that the public utility holding company as a recognized instrument of finance is not the subject of criticism at this time, but rather the possibility of the abuse of the relation of the holding company with its subsidiaries. There seems to be the fear, which in some noted cases would seem to be justified, that holding companies may be used to exploit their subsidiaries and by way of excessive management fees for services rendered

**Excerpts from address before Missouri Association of Public Utilities, Excelsior Springs, Mo*

or pyramided financial structure so increase the operating expenses of their subsidiaries as to affect the rates to the consumer.

In a great majority of cases holding companies have played a helpful and constructive part in the development of the public utility industry, and without some such financial structure it would have been impossible for public utility services to have made such a great contribution to the economic and social life of the country. In relatively few instances has the holding company been used to exploit the operating company, but this is reason to condemn all holding companies.

The rate payer must be convinced that the fees charged by the holding company for services are just and reasonable and, in my opinion, the best way to achieve that confidence is to have the compensation of the holding company approved by a public service commission. If the commission had authority to pass upon the contractual relations between holding companies and their subsidiaries, there would be no more reason for the regulation of the holding company in the public utility field than in any other field of American business.

I realize that the proposal that management fees of holding companies should be approved by public service commissions will not meet with the general approval of public utility executives, but I am convinced that it is necessary, in order to strengthen the principle of state commission regulation, that such agencies be fully informed of all factors which enter into the consideration of rates and service.

Criticism of our rates is based largely on the feeling that they have been constructed to yield returns on excessive and inflated property values. Disputes over valuation have given rise to costly and prolonged cases before public service commissions, and frequently result in protracted litigation in both state and federal courts.

All thoughtful students of the theory of valuation are agreed that the value of the properties of utilities should not be subject to violent fluctuations of price levels; that the temporary advantages gained under reproduction values will be offset in a long period of declining prices such as we are now experiencing. The truth probably will be found in the middle of the road, and it is the part of industrial and economic statesmanship to find it.

The guiding principle in rate making should be not "all that the traffic will bear," but how low can the rates be reduced to meet competition and to induce the largest possible use of our services.

Instead of insisting upon the strict application of the valuation principles announced by the United States Supreme Court, it would seem to be the part of wisdom to co-operate with all those seeking to find a permanent and satisfactory solution of this question, and to give serious and sympathetic consideration to the various suggestions which are now being made by earnest students of this problem. If a principle for the valuation of public utility properties could be determined at this time on some basis which would command the support of the public and owners of the properties, this vexatious question would disappear from the field of public discussion.

I believe that our industry is capable of policing itself. It is inevitable, in an industry which has grown so greatly and which has faced so many new and difficult problems, that mistakes have been made, unsound financial practices have been followed in some instances and unwise managerial policies put into effect in others. It does not seem to me, however, that anything constructive will be accomplished by destroying the industry for the sake of punishing a few.

I firmly believe that if public opinion will exercise its discrimination it will soon be possible to separate the sheep from the goats.

With the wide diffusion of ownership of public utility securities and the consequent divorce of ownership from management there is developing a distinct class of men and women charged with the responsibility of management and operation who have little financial interest in the properties they operate. They realize that these properties shall be operated only in the best interests of the public as a whole. The result is that the standard of conduct—the code of ethics—of the operators of public utility properties is on a much higher plane; in fact, it is approaching a stage in its development where the industry ceases to become a trade and becomes a profession.

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Protection Against Failure to Remove Field

By E. H. BANCKER
Central Station Engineering Department, General Electric Company

Where a separate excitation system is employed it is sometimes used to reduce the coasting period of turbo-generators which have been removed from service. The application of field to the generator greatly assists in retarding the set and brings it to a standstill much more rapidly than if left to itself. During the interval between the opening of the oil circuit breaker and the final stopping of the machine the operator's attention may be required elsewhere and the field may be inadvertently left energized after the machine has come to rest. In a few instances this has resulted in a burnout, which might have been avoided had there been some more obvious indication of the presence of field than merely the circuit breaker's position.

A very simple form of alarm is provided by a direct-current voltage relay connected across the field and an auxiliary switch on the generator oil circuit breaker. The contacts of the voltage relay and the auxiliary switch are connected in series to operate a visual or audible alarm whenever voltage is present across the field and the oil circuit breaker is open. The alarm will also be given prior to synchronizing the machine during the starting period, but during this interval the operator is obviously aware of the fact that he has field on the machine and has not yet closed the circuit breaker. When an audible alarm is used it is advisable to employ a small buzzer or some device which will not prove annoying during the coasting period, but which will call attention to the fact that field is still applied to the machine. The voltage relay need only be of the simplest, such as a plunger type like the PQ, with a coil designed to operate without overheating at the highest field voltage normally used.

Decentralizes Responsibility for Operating Procedure

By GEORGE TOWAR
Detroit Edison Company

WHAT has proved to be a decided forward step toward safety and smoothness in operating procedure has recently been inaugurated by the Detroit Edison Company. The new arrangement is, in effect, a decentralization of operating responsibility. The change was based on the fundamental theory that the man in direct charge of a given piece of equipment is most familiar with it and, other things being equal, is therefore best equipped to assume the responsibility for all details of its operation. It is felt that this advantage of proximity will more than offset a much greater general experience which might be possessed by a man acting as a remote supervisor.

Formerly, in so far as operating and protective procedure was concerned, the attendants in charge of major electrical equipment at power plants, substations and on transmission lines acted principally as agents of a centralized group of dispatchers known as "system operators." Of course, the attendants were always responsible for the custody and maintenance of the equipment in their charge. As the system became more complex, it became evident that a time was approaching when any central group would find it impossible to be intimately acquainted with the necessary details. Accordingly the decision was reached that attendants in charge of stations should have more responsibility shifted to them and that they alone should be designated as "operators." At the same time, the old system operators were designated as "system supervisors." Their former name was a misnomer as they had not actually operated, but only directed operations. The operators were given the responsibility for the control of all physical apparatus under their charge. The supervisors were authorized to assume control of this equipment to the extent necessary to co-ordinate the procedure of several operators, under normal or emergency conditions. Of necessity, certain equipment, such as transmission lines, remained under the control of system supervisors as it is impractical to assign it to the local control of an operator.

After settling the operating procedure, protective practices came in for co-ordination with the new order of things. Previous to this time, the tagging system had developed as a highly centralized procedure, always directed by the former system operators. A code was established containing the principles of a protective tagging system applicable to all electrical apparatus used for generation and distribution; it was also applied to mechanical equipment where the application was analogous. In framing thet new code the various departments concerned in the problem were consulted. All of them agreed that blocking out equipment for the protection of workmen should be suitably advertised by tags conspicuously placed on controls at the sources of hazard. However, a great many different kinds of tags were suggested, many simply indicating an unusual operating condition rather than advertising a protective necessity. To have used a multiplicity of tags, as suggested by some, would have diffused the force of any one, so it was decided to adopt only two protective tags. One is used by and under the control of the operators. The other is used by the supervisors, to be placed and removed on their orders only. It is emphasized that both tags are to be known as "red tags" and are to be treated with equal respect. The supervisor's tag is a red card with white lettering, while the operator's tag is a white card with red lettering.

Under the new code each department was assigned the duty of framing a set of rules which would be applicable to the apparatus in its operating charge. But to insure co-ordination or compliance with the basic code, the departmental rules were passed upon by the executive in charge of the electrical system operation. Following is an example of the application of the code and rules:

Assume that work is to be done on a main transformer in a substation. The department wishing to do the work submits a request for a shutdown to the operating authority in jurisdiction. When this request is approved the necessary prearrangements are made. The leader of the group of workmen which is to do the work makes application for protection to the operator in charge of the equipment. The leader must have sufficient natural intelligence and long experience to understand the hazards involved and the safety protection necessary. The operator

Supervisor's and operator's warning tags

Both are "red tags." But the system supervisor's tag is printed white on red while the operator's warning is red on white.

isolates the apparatus by opening circuit breakers, disconnect switches and removing switch control circuit fuses. He fills out red tags and places them on the breaks that are sources of potential. He also installs whatever auxiliary blocking devices are necessary and places red tags on them. The work leader is required to accompany the operator to each source of hazard and verify for himself that the protection is adequate and what the limits of the protection are.

All these precautions are recorded on the request form and signed by the operator and the leader. The contract having been recorded, the protective devices remain "as is" until the leader reports "clear" to the operator, which means that the protection provided him and his men is no longer necessary and, so far as they are concerned, the equipment that they have been working on is ready to be returned to service.

Procedure when protective measures outside local jurisdiction are needed

If the apparatus is of such a nature that a station operator cannot himself furnish all the protection necessary (as, for instance, an interconnecting line) he calls the system supervisor and asks that protection be provided at sources of potential outside of his jurisdiction. The supervisor then orders this protection applied by his tags at the other station, records his part of the transaction and reports to the operator in charge of the station where the work is to be done. The operator then completes the transaction with the work leader.

When work is to be done on equipment between stations (as, for instance, a transmission line) the transaction comes under the system supervisor, principally because there is no operator at the point of work. Here, as in the previous case, the department submits a request for shutdown of the equipment involved. Approval and arrangements for the shutdown are handled in the same manner. The leader of the group of workmen makes application to the system supervisor for the necessary protection. In this kind of a prearranged job the supervisor attempts to have the line removed from service before the leader calls. However, red tags are never placed until the leader has verbally requested protection. The supervisor then orders that the protective breaks at sources of potential be red tagged with his tags by the respective operators, who, in this case, act as his agents. When this is completed the supervisor gives the leader permission to work and explains the protection provided.

Throughout the whole procedure all conversations between parties are carefully repeated and it is required that all parties be convinced that the protection provided is adequate and that the understanding is common. A detailed record is made by the supervisor of the whole proceeding. The line is not returned to service until the work leader has given his clearance to the supervisor, as he did to the operator in the other case.

In the event of emergency work on a transmission line, the procedure is practically the same except that written prearrangements are not made and all understandings are made verbally. To cover situations where the authority of a supervisor is needed, but where local conditions do not lend themselves to telephone communication, an operator is given authority to act.

This decentralized system of operating practice has been in effect now for more than a year with very gratifying results. The burden of operating detail has been so spread that no group is overloaded and in each case the men who are most familiar with the equipment have the responsibility for handling it correctly.

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A Hundred Foot-Candles of Supplementary Lighting

By M. LUCKIESH

Director Lighting Research Laboratory, General Electric Company, Cleveland, Ohio

The lighting of workplaces to a much higher level of illumination than the surroundings has been considered undesirable because of the brightness difference involved and the assumption that vision is not at its best when a small field is seen in the midst of darkness as in most optical instruments.

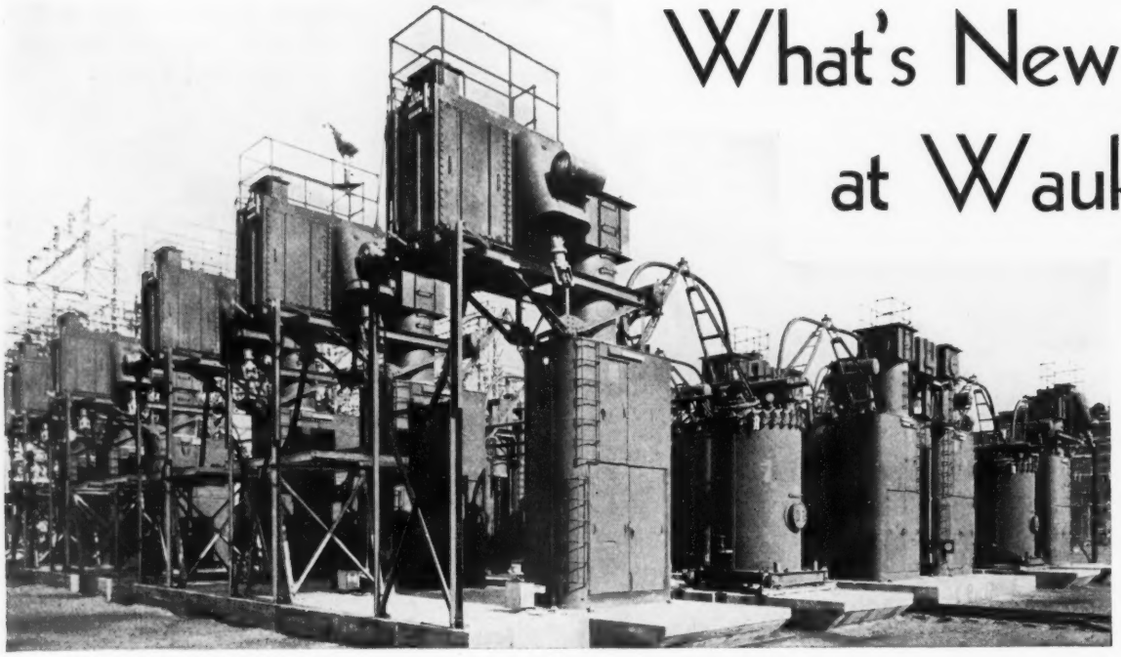
The data to be presented indicate the inapplicability of this objection to the raising of the level of illumination upon the work considerably above that of the surroundings. The criterion used was the precision of seeing and a total of 400,000 observations were made by a number of persons. The object to be seen was located in the center of a bright area which was varied in size so that it subtended angles at the eye from 6 to 70 deg., or, at 10 ft. from the subject, an area of 1 to 140 sq.ft. The field surrounding the bright area was dark.

Between the smallest and largest of the bright areas used there was a difference of about 7 per cent in the precision of seeing. The data indicated that most of the disadvantage of the less bright surroundings or outlying area occurs when the brighter central area subtends less than 30 deg. at the eye or is less than 1 sq.ft. at 2 ft. The area surrounding workplaces to be illuminated locally to a high intensity may, therefore, be quite restricted in size before the effect on vision becomes significant.

This investigation was made at one level of brightness, 10 millilamberts, corresponding to 11.6 foot-candles on a white surface of 80 per cent reflection factor. In practice, with the low reflection factors often found in workplaces, 10 millilamberts may represent as much as 100 foot-candles of illumination. Therefore, the measurements are within the range of intensities of illumination used in lighting and are conservative, since the most distracting condition was used, that of a bright field sharply defined amid dark surroundings.

These researches indicate that with good general lighting the spot of localized high-intensity illumination could be many times as bright as the surroundings without noticeable eye discomfort provided the spot receiving localized supplementary lighting is about 30 deg. or more in angular extent. As to eye fatigue, it is still difficult to estimate how much of the effects of this factor are included in the foregoing results. However, it is interesting to note that "resting the eyes" temporarily by looking away from the work is chiefly accomplished by the resulting muscular and mental relaxation rather than by a change in brightness. Therefore, if the contrast between the brightness of the "workfield" and that of the surroundings is not great enough to cause noticeable discomfort, it is likely to contribute little to eye fatigue.

What's New at Waukegan



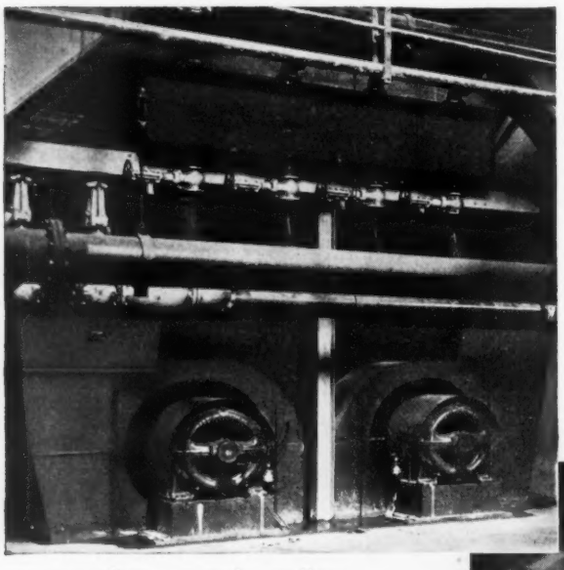
Cable in place of rigid bus

The bus of the 132-kv. switchgear consists of 3,000,000-circ.mil cable in a series of loops between the various pieces of equipment. These loops are supported on isolated racks raised about 8 ft. above the foundation levels. This bus cable is used also to connect the new metal-clad switchgear installation with the previously installed open-type switching structure.

Instead of the usual outdoor type bushings the oil switches in the metal-clad gear are provided with potheads, from which connection is made by cable to associated disconnecting switches. The oil circuit breakers are rated to carry 1,200 amp. continuously without overheating and they have an interrupting capacity of 2,500,000 kva. at 132 kv.

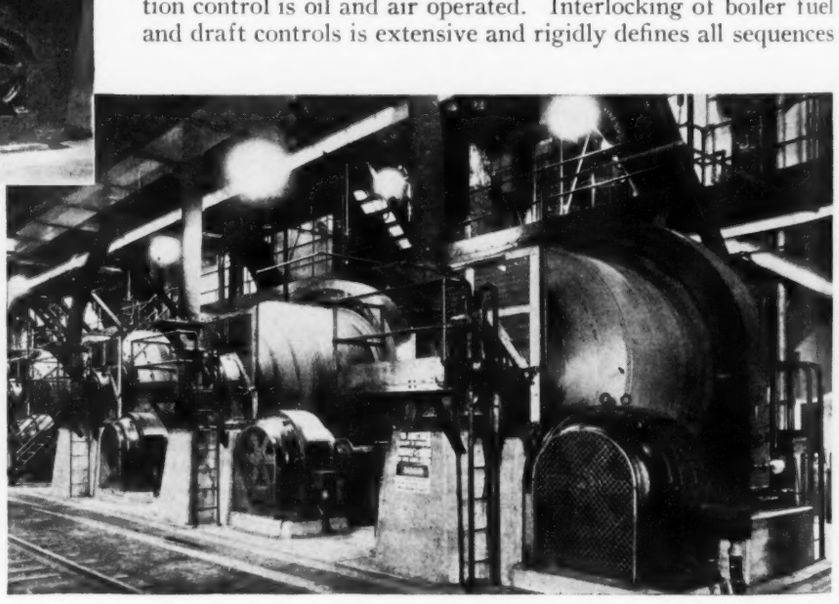
THE fifth unit just recently put in operation at the Waukegan station of the Public Service Company of Northern Illinois is not the only new and exceptional characteristic of the latest addition to this important power source feeding the great Chicago pool. The new unit, a single-winding generator of 115,000 kw. at 95 per cent power factor, brings the total capacity of the station to 290,000 kw. The generator rotor is reported to be the largest forging ever made in this country. It weighed 135 tons before machining.

The boiler installation consists of two standard and one reheat boilers, each fired by three unit mills. The boilers are of the horizontal single-pass type, equipped with air heaters and economizers and with complete water-cooled furnace walls and bottom. All furnaces are of the slag-tap type. Combustion control is oil and air operated. Interlocking of boiler fuel and draft controls is extensive and rigidly defines all sequences



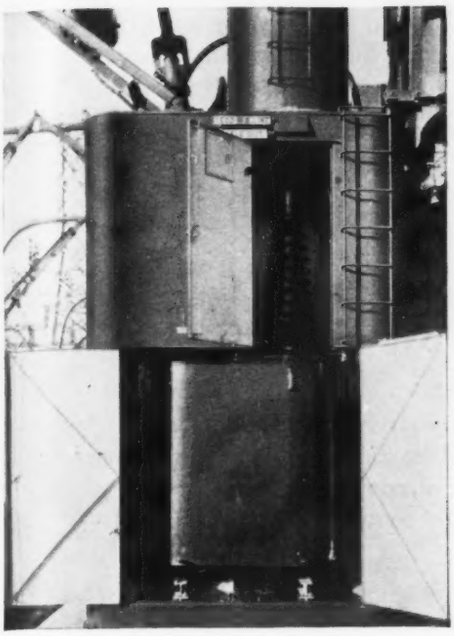
Generator air cooling

Four fans with a total capacity of 200,000 cu.ft. per minute force the generator air supply through a fin-type cooler. Either condensate or circulating water may be used as the cooling medium.

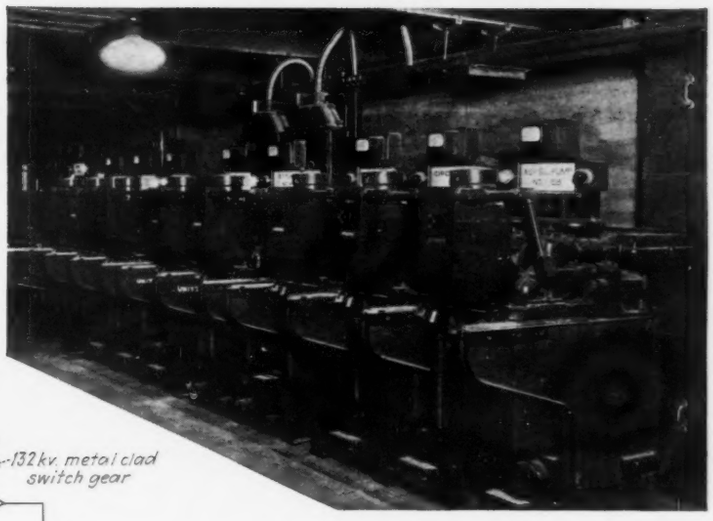


Unit mill firing is used

Each boiler is supplied with pulverized coal from three tube mills, equipped with disk feeders. Variation of coal feed is obtained by brush-shifting motors which are controlled from the boiler-operating panel. The mills are driven by 300-hp. motors and the mill exhauster by 75-hp. motors, both constant speed. Each mill has a maximum rating of 14 tons per hour, supplying coal through two cross-tube burners which produce a short horizontal, turbulent flame.

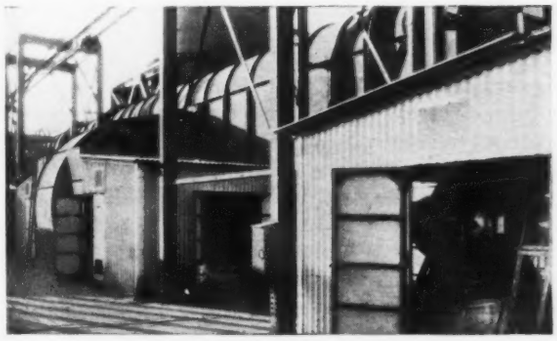


Metal-clad gear serving 2,300-volt auxiliaries



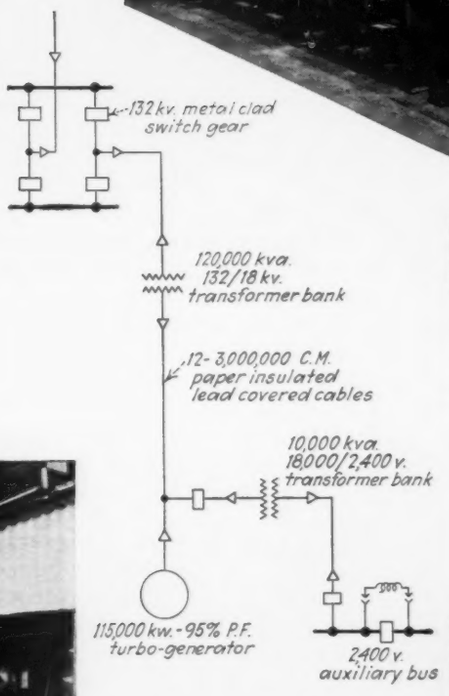
Breakers lowered to disconnect

Units travel vertically on motor-driven jack-screws and they can be operated in groups or individually when desired for test purposes. Housings are designed so that it is possible to check position of switch through a sight glass in upper door.



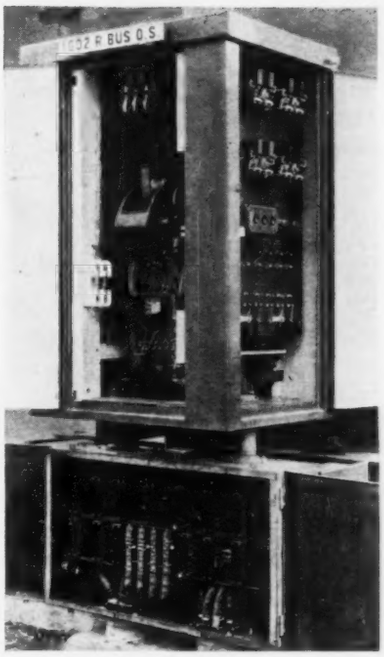
Induced draft fans on roof

Each boiler has one induced-draft fan located on the boiler-house roof adjacent to the breeching and the motors are protected by transite housings, not shown in the picture. Each fan is driven by two motors, one adjustable-speed induction type to provide a range up to 514 r.p.m. for normal operation and a constant-speed induction motor of 720 r.p.m. for maximum conditions. The fan rotors are especially designed to reduce erosion from fly-ash.


132 kv. metal clad switch gear
120,000 kva. 132/18 kv. transformer bank
12- 3,000,000 C.M. paper insulated lead covered cables
10,000 kva. 18000/2,400 v. transformer bank
115,000 kw.-95% P.F. turbo-generator
2,400 v. auxiliary bus

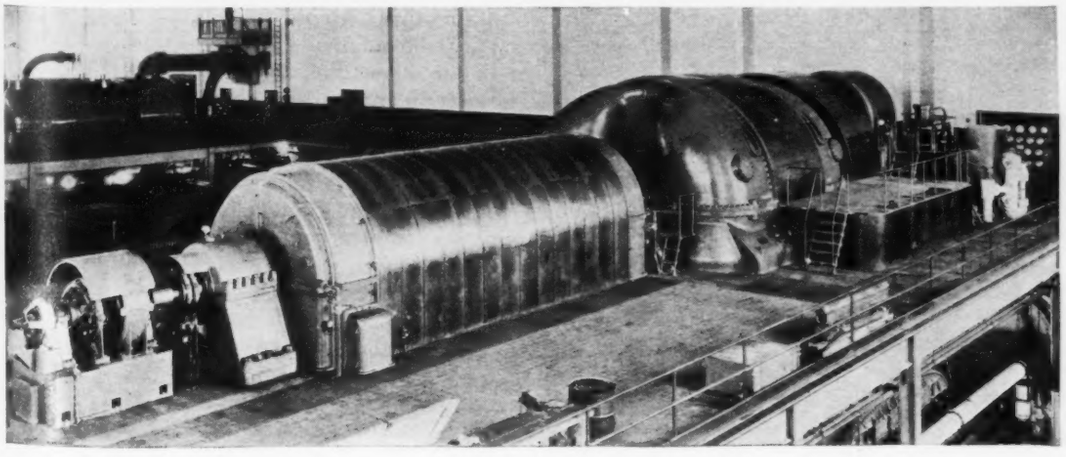
The new unit layout

The electrical connections of unit No. 5 differ from preceding installations in Waukegan. There are no generator bus or generator oil circuit breakers because the generator and transformers are considered an operating unit and breakers are provided only on the 132-kv. side of the transformers. Another departure from previous practice in this station is the connection of the 10,000-kva. auxiliary transformer to the generator leads.



Emphasis placed on accessibility

This detail of a control assembly for one of the oil circuit breakers shows how adequate housing for control devices has been provided without in any way sacrificing accessibility to them.



115,000-kw. single-winding turbo-generator unit

The turbine is of the two-cylinder tandem-compound reaction type with double-flow low-pressure cylinder. Steam is withdrawn from the high-pressure cylinder at about 200 lb. pressure and after reheat to 750 deg. F. is returned to the same cylinder. The turbine is designed for 650 lb. throttle pressure and 750 deg. F. steam temperature. The generating voltage is 18,000.

of operation. A feature of the coal-handling equipment is in its use of alternating- instead of direct-current motors.

Probably the most significant thing electrically about the new Waukegan addition is the use of the very latest developments in metal-clad switchgear for both generating and output voltages. The output of the new unit is stepped up to 132 kv. by a transformer bank of 120,000 kva. The 132-kv. switchgear consists of two double bus positions with current capacities of 1,200 amp. The switchgear occupies a ground space of approximately 5,500 sq.ft. per double bus position.

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Some Aspects of Domestic Air Conditioning

By W. M. TIMMERMAN
Commercial Engineer General Electric Company

Why homes should condition air.
Humidification necessary and limitations.
Extent of cooling desirable.
Types of systems that may apply.

THE condition of the air in which we live and which we breathe day in and day out may have a much greater effect on our health and vitality than any of us realize at the present time. Every one knows from experience that he is neither comfortable nor effective when the temperature is either too high or too low, or when the humidity is either too high or too low. Further, we can readily imagine that the tremendous amount of dust in the air of our cities has an effect on our well being. Information is gradually being accumulated showing just how each of these factors affects us. Some investigators are developing the theory that changes in climatic conditions may have been one of the principal factors in the rise and fall of civilizations in the past.

The obvious conclusion from these investigations is that we should so control the atmospheric conditions in which we live as to enable us to enjoy the maximum of health and vitality. The use of air-conditioned homes, offices and all places where people gather may make it possible for a progressive civilization to develop in large sections of the world which are now entirely unsuited for human habitation and progress.

**Excerpts from an address before Cleveland chapter A.I.E.E.*

Table I—Fuel Savings from Insulation of Residences

U. S. Department of Commerce Bulletin
U. S. Bureau of Standards Circular No. 376

	Fuel Saving, Per Cent
Weather stripping	15–20
Plus double windows	25–30
Plus ½-in. insulation	50
1-in. insulation	60
Cost of ½-in. insulation $120 to $200	
1-in. insulation $200 to $300	

Table II—Recommended Indoor Conditions for Summer

From American Society of Heating and Ventilating Engineers' Guide

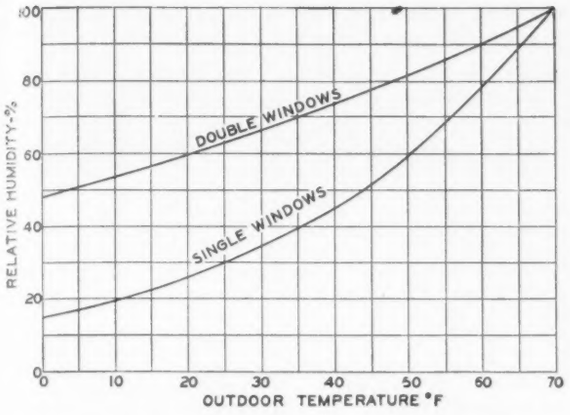
Outdoor Temperature, Deg.	Indoor Temperature, Deg.	Indoor Relative Humidity, Per Cent	Indoor Effective Temperature, Deg.
95	80	45	73.4
90	78	47.5	72.2
85	76.5	50	71.1
80	75	52.2	70.2
75	73.5	56	69.3
70	72	60	68.2

By complete air conditioning we mean: (1) Proper heating and humidification in winter. (2) Proper cooling and dehumidification in summer. (3) Air purification the year round.

The air in our heated homes in the winter time is drier than the air in the Sahara desert. This surprising condition is true and we suffer as a result of it. When outdoor air at a temperature of 30 deg. and relative humidity of 70 per cent is heated to a temperature of 70 deg. the relative humidity drops to 17 per cent. When outdoor air at a temperature of 20 deg. and 70 per cent relative humidity is heated to 70 deg. the relative humidity drops to 10 per cent. This extremely dry air dries the mucous membranes of our nose and throat, which seems to make us more susceptible to colds and respiratory diseases in the winter time. Our furniture also suffers from this dry condition, the wood cracking and the glued joints drying and opening up. Rugs and fabrics lose their moisture and become brittle, making them much more susceptible to wear. Relative humidity indoors in the winter time should be approximately 50 per cent instead of the 5 to 20 per cent which we now have.

To maintain this relative humidity in the average home it is necessary to add from 8 to 24 gal. of water to the air per day, the exact quantity depending on the size of the house and the type of construction, which in turn determines the amount of infiltration of outdoor air each day.

The limitation in humidification of our present residences is at the point where condensation begins to appear on the windows and in some cases even on the walls. The accompanying illustration shows the indoor relative humidity at which condensation on the windows begins with various outdoor temperatures. For example, with an outdoor temperature of 30 deg. single glass windows will begin to sweat when the relative humidity is approximately 35 per cent. With an outdoor temperature of 20 deg. condensation takes place at a relative humidity of about 26 per cent. With an outdoor temperature of 10 deg. the maximum humidity that can be obtained indoors is about 20 per cent. From this it is evident that we are definitely limited in the amount of humidification that can be accomplished with single glass windows.



Per cent relative humidity at 70 deg. F. at which condensation begins on windows

Before we can economically cool our homes in summer it will be necessary to insulate them. Insulation can also be justified by the saving it will produce in our heating costs. Table I shows data taken from U. S. Bureau of Standards circular No. 376, giving the fuel savings which can be realized in the average residence by weather stripping, using double windows and ½ and 1 in. thicknesses of insulation.

The second function of air conditioning is to cool and dehumidify in the summer time. Investigations conducted by the American Society of Heating and Ventilating Engineers show that the indoor temperature and humidity in summer should vary with the outdoor conditions. Table II gives the recommended indoor conditions for various outdoor temperatures. Excessive cooling in extremely hot weather is to be avoided in order to prevent shocks to people going from outdoors to a conditioned space, or *vice versa*.

The methods of cooling residences might be divided into two groups, namely, a central system or a system of individual units. The central system might again be divided into forced-air systems, in which complete refrigerating equipment is installed in the basement and air is circulated by forced convection throughout the house and into circulating cold water systems in which water refrigerated in the basement is circulated to individual coolers in the various rooms. A multiple refrigerant system would consist of a condensing unit in the basement with refrigerant piped to direct-expansion unit coolers in the various rooms. The individual units might be of the self-contained type in which a water-cooled refrigerating machine with a direct-expansion cooling coil or a refrigerated water spray are housed in one cabinet which is placed directly in the room to be conditioned. With a remote arrangement the condensing unit would be located in some room other than the one that is to be conditioned and either refrigerant or cold water should be piped to the unit cooler.

Table III—Estimated Operating Costs for Cooling 14,000-Cu.Ft. Insulated Residence

(Based on 2 cents per kilowatt-hour)

Boston	$25 to $30
Washington	$45 to $60
St. Louis	$65 to $80
New Orleans	$100 to $135

The operating costs for cooling and dehumidifying residences will, of course, vary with the climatic condition. Table III gives estimated operating costs for the summer season based on 2 cents per kilowatt-hour for a 14,000-cu.ft. insulated residence.

It is not economical to use electrical energy in straight-resistance units for house heating; however, if the electrical energy is put into the motor of a refrigerating unit the refrigerator can be used to pump heat from the cold outdoors so that the total heat dissipated inside of the house is equal to the electrical input to the motor plus the heat which is transferred by the refrigerator. In this way several times the heat equivalent of the electrical input can be obtained. There are definite limitations to such a system, but it may prove to be economical for climates having very mild winters and hot summers.

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How Low Is Infinity on a Megohm Meter?

By R. H. MARVIN

Johns Hopkins University, Baltimore, Md.

A commonly used standard of insulation resistance is that the resistance shall register infinity on a "megging" device of a certain voltage rating. By this is merely meant that the instrument shall show no visible deflection from its infinity position. The phrase is, however, vague, and in many cases it would be desirable to know more definitely how low the insulation resistance may actually be under this condition. Evidently this requires a knowledge of the law of the deflection of each particular instrument.

For instance, in the Evershed meter the moving system has two coils, a potential coil connected directly across the generator and a current coil in series with the resistance to be measured. The potential coil tends to bring the pointer to the infinity position, which it will do if there is no current in the current coil. The current coil tends to deflect the pointer, the current being determined by the resistance. For small deflections from the infinity position the potential coil exerts a constant restoring force and the current coil a force directly proportional to the current:

Let:

θ = deflection of pointer from infinity position, most simply measured as linear distance along the scale.

E = voltage of megohm meter generator.

I = current at deflection θ.

R = megohms at current I.

Then, $I = \dfrac{E}{10^6 R}$

Also, since the deflection is proportional to the current,

$I = A\theta$, where A is a constant.

Eliminating I between these two equations,

$$R\theta = \frac{E}{10^6 A} = \text{a constant.}$$

That is, the product of the resistance by the deflection is a constant. The following table gives the actual values

for the instrument used by the writer. This is a 500-volt instrument, the highest numbered graduation being 40 megohms. For convenience the distance θ from the 40 megohm point to infinity on the scale is taken as unity, although in the "megger" used it was actually 3 mm.:

R	θ	R
40	1.00	40
30	1.33	40
20	2.00	40
15	2.67	40
10	3.80	38

Proportionality holds, therefore, to as low as 15 megohms.

Evidently then, to find the value of any deflection between the highest scale value and infinity we have only to divide the highest scale value by the proportion that the actual deflection from infinity is to the distance from the highest scale value to infinity. Thus with the instrument just mentioned, if the deflection of the pointer from infinity were two-tenths of the distance to the 40-megohm mark, then the resistance would be 40 divided by two-tenths; that is, 200 megohms.

To check this conclusion the device was used to measure a number of sputtered metal resistances which had been carefully measured with a sensitive galvanometer. The results are shown in the following table:

Resistance, Megohms	Deflection from Infinity, θ	Resistance Calculated from Deflection, Megohms
95	0.4	100
198	0.2	200
306	0.1	400
412	No definite deflection	

Allowing for the errors of visual interpolation, the agreement is good.

We may assume that a deflection of one-tenth would certainly be noticed, so that we are justified in saying that for an instrument of this voltage and graduation a reading of infinity is not less than about 400 megohms.

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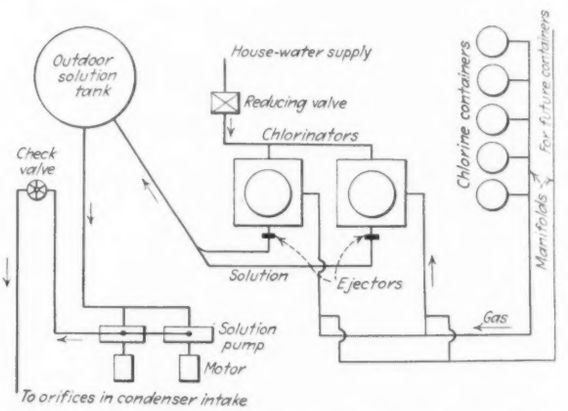
Condenser Performance Improved by Chlorination

The Hartford Electric Light Company recently joined the list of steam plants using the chlorine treatment of condenser circulating water to eliminate fouling from bacteria formation, and since September 15, 1931, a saving of about 4 per cent in fuel consumption has been realized in this way. The chlorinating installation at the company's South Meadow station has a number of interesting features, including an outdoor solution tank instead of the customary housed storage; duplicate chlorinators, manifolds and solution pumps, and provision for doubling the number of chlorine containers per manifold in case increased capacity is needed later. Adjustable time clock control of the pumps is also utilized.

Since the equipment was installed the average vacuum has been about ½ in. greater than before. The plant equipment includes two 20,000-kw. units and one 40,000-kw. machine, the large unit being normally run on a 35,000-kw. base load about twenty hours per day. With this station output and one circulating pump operating, the absolute pressure in inches of mercury at the turbine exhaust with 35-deg. F. intake water has ranged from 0.7 in. to 0.75 in. The intake water is drawn from the Connecticut River and at present about one part of chlorine to 2,000,000 parts water is used. The solution tank has a capacity of about 700 gal. and 10 tons of crushed limestone to hold the chlorine mixture chemically stable and keep the chlorine from escaping. About 147,000 gal. of circulating water per minute is required with all three generating units in operation at approximate rating, calling for about 250 lb. of chlorine per 24 hours.

The rate of chlorine feed from the container battery and the amount of water flowing into the system are adjusted to fill the solution tank in a little under one hour. At present the program clock, through relay connections, switches on the solution pump for about eight minutes' run per hour, the pump delivering the solution from the storage tank through the piping system into the intake. Two "Olivite" solution pumps are provided,



Duplicate chlorinators are alternately operated as desired in tank filling

Ultimately either chlorinator can be operated on either of two container batteries.

each direct driven by a 7.5-hp. 220-volt, three-phase induction motor. A check valve is provided in the delivery line from the pumps to prevent siphoning the solution out of the tank and atmospheric discharge connections from the chlorinators are installed to provide an outlet in case the vacuum breaks in the bell-glass chambers. Ejectors at each chlorinator force the solution into the storage tank after the liquid chlorine has been vaporized and mixed with water at the chlorinators. Either chlorinator can be operated off either gas supply line. The usual rubber linings are provided for piping, pumps and valves.

It is expected that it will be unnecessary to clean condensers except in case of trash, eels or leaves accumulating. Doing away with the previous cleaning requirements under the usual wet conditions and cramped quarters is a decided advantage. To clean a condenser at South Meadow in the past meant inserting 6,000 rubber plugs in the tubes, blowing the plugs through the tubes with compressed air and collecting them, the condenser, of course, being shut down at the time. The equipment was furnished by Wallace & Tiernan Products, Inc., Belleville, N. J., and is an adaptation of water-chlorinating apparatus for municipal service to steam plant practice.

Purchased Power Has Place Even in Process-Steam Industries

By RALPH M. HIBNER
Consulting Engineer E. I. du Pont de Nemours Company

Process-steam-using industrial plants represent one of the least saturated markets so far as sales of utility-generated power is concerned. How are they going to be interested in purchase of power? The answer is going to come from an understanding of their problems.

Here is the way the consulting engineer for one widespread industrial organization expressed his problem to a group of power sales engineers at the Interstate Power Club recently. Out of the 81 industrial plants composing this organization 57 purchase all power, eleven purchase part and thirteen generate all their energy. The company insists that any investment made shall save its cost in three years.

THE importance of maintaining a correct steam balance in a large manufacturing plant, or in any plant regardless of size or character, should be at once apparent. The term "steam balance" brings to our minds the picture of an operating plant where there is no appreciable amount of steam exhausting to the atmosphere. The degree to which this condition is maintained in a large measure determines the total cost of power consumed. But even the elimination of all visible wastes does not complete the picture, as will be pointed out later.

The question of steam balance involves the operation of practically all power-house equipment and in addition many phases of plant-manufacturing operations. In past years it was considered adequate economy to operate steam-driven boiler auxiliaries at approximately 5 lb. back pressure and to exhaust this equipment into an open feedwater heater. Any other steam-using prime movers were exhausted into a low-pressure heating system in winter and during the non-heating seasons were exhausted to atmosphere. This procedure was a step in the right direction, but usually was not the most economical scheme possible. The next step was to provide electrically driven stand-by equipment, and thus in summer only sufficient steam units were operated to provide adequate heating of boiler feedwater and to supply any processes which could use steam at approximately 5 lb. pressure.

If large quantities of steam at low pressures were required by the plant processes the bleeder type turbine was installed. The by-product electricity thus generated is very low in cost. When extracting the maximum quantities of steam only a nominal amount is condensed, and therefore the boiler load is only slightly greater than when supplying the steam directly from the mains. In this case the added investment consists only of the generating and condensing equipment.

Today many of our larger plants have resorted to more intricate schemes to produce a correct heat balance. The present goal is not only to prevent all wastes but also to obtain as much useful work as possible from the heat units of the steam. Accordingly boilers or steam generators of increasingly higher pressures have been installed. Boilers with operating pressures of 450 lb. are becoming more numerous every day, and occasionally even higher pressures, up to 1,400 lb., are being used. The manufacturing plant utilizes the high-pressure steam through straight back-pressure turbines driving electric generators. The steam is exhausted at pressures up to 200 lb. and occasionally as high as 350 lb., depending on the requirements. This exhaust, in turn, is used for the usual boiler room, engine room and process requirements. We now have the problem of again maintaining a balance of the exhaust steam.

However, in this case the demand for steam determines the amount of electric load which will be carried on the high-pressure generating unit. Any deficiency in electricity must then be made up either by generating with low-pressure units or by purchase.

These are only a few of the methods which can be used to utilize to the utmost the heat content of the steam generated in the boiler plant.

There are many schemes to which we can resort in order to maintain a correct steam balance, but the selection of the most economical method and equipment is usually a complicated problem. This problem is influenced by a large number of conditions, many of which are constantly varying.

First, the type of plant must be considered. Our problems usually are concerned with one of the following:

1. A new power plant to supply power for a projected plant.
2. An old power plant which does not have sufficient capacity for newly expanded manufacturing facilities.
3. An old plant which is uneconomical and which can be replaced in part or entirely on a savings basis.

The conditions of the plant to be investigated as outlined above often determine the degree to which capital

will be expended in order to obtain a low-operating-cost plant. The ultimate selection is that new or revamped plant which will provide the greatest return on the investment.

Load conditions also have a very pronounced effect on the selection of equipment. We must consider:

1. The relation of average steam and electric loads to the minimum and maximum demands.
2. The relation between the steam and electric load.
3. The variation in these loads with the seasons of the year.

As an example of the above conditions, a straight back-pressure turbo-generator is extremely useful when the steam and electric load curves closely parallel each other and also when the relation between the two loads is such that a water rate can be obtained on the turbine which will supply a large percentage of the steam required.

If, on the other hand, the steam and electric loads are widely divergent, this type unit does not produce a large return on the investment. Again the hourly and seasonal variations may produce very unfavorable balances at certain periods, so that the fullest benefit of the equipment is not obtained.

In the use of both back-pressure units and extraction-type machines the steam load curves can be "smoothed out" by the use of one or more stage heaters. For balancing large seasonal variations in the demand for low-pressure steam mixed-pressure turbines are occasionally used. However, in my experience this type of installation is not common, as the load fluctuations are generally compensated for in some other manner.

The use of full condensing generating units has practically no influence on the actual steam balance of a plant. Their use is, of course, in direct competition with the central-station companies. The economics of generating or purchasing electricity is readily ascertained by direct comparison of costs. Generation by condensing equipment is not usually the economical procedure except where abnormally high utility rates prevail or when fuel is extraordinarily low in price. While the cost of fuel does not have a large influence on the cost of electricity furnished to the customer by the central-station company, it forms a much larger percentage of the cost of power generated in the smaller units of the manufacturing plants.

Thus far we have considered only power-house equipment in establishing the plant heat balance. In many plants the installation of back-pressure machines at the location of a particular operation is common practice. In such operations where appreciable quantities of low-pressure steam are used for process work, such as driers, stills, evaporators, water heaters and similar equipment, back-pressure units are often found to be economically justified. In this case the equipment consists of turbines or steam engines which are used to drive pumps, blowers, refrigeration units, air or gas compressors and occasionally mechanical equipment.

A plan of this kind involves the maintenance of a steam balance in a restricted area, and of course forms an important cog in the heat balance system of the entire plant.

In a few instances the reclamation of heat from process equipment is resorted to in order to obtain make-up water of relatively high temperature for the boiler feedwater heater. Condensate returns are also utilized where it is feasible to do so, but usually on large plants where the process buildings are at a considerable distance from the power house this procedure is not justified. The use of hot water from processes or condensate returns of course influences the low-pressure steam load at the power house and has an important bearing on the power-house operation.

The entire question of steam balance becomes one of economics. In order to utilize high-pressure and back-pressure turbines or extraction units it is necessary to increase the investment to a considerable extent. Thus all studies of this character must consider not only the operating costs but also the amount of investment necessary. The maintenance of a correct steam balance is nearly always closely allied with the generation of electricity, and therefore the public utility rates for power service play a prominent part in all heat balance calculations.

In many plants today it has been proved that it is economical for the manufacturing company to purchase a portion of its electrical requirements and to generate that portion which has a definite bearing on the steam balance.

This statement is not intended to define a set rule, for in numerous instances the steam balance can be satisfactorily obtained without involving the electrical supply in any manner. In these cases it is simply a matter of comparative costs of generating or purchasing, with purchased electricity generally proving to be the most economical. The statement is a general principle to be modified by particular conditions.

Usually the public utility companies have been willing to supply current with the customer's equipment operating in parallel with their service. When it is economical for the customer to generate a portion of the load we believe this arrangement should be satisfactory to all concerned. If parallel operation produces cheap power for the customer it places him in a strong position, his chances for expansion are increased and he eventually becomes a still larger customer of the central station company.

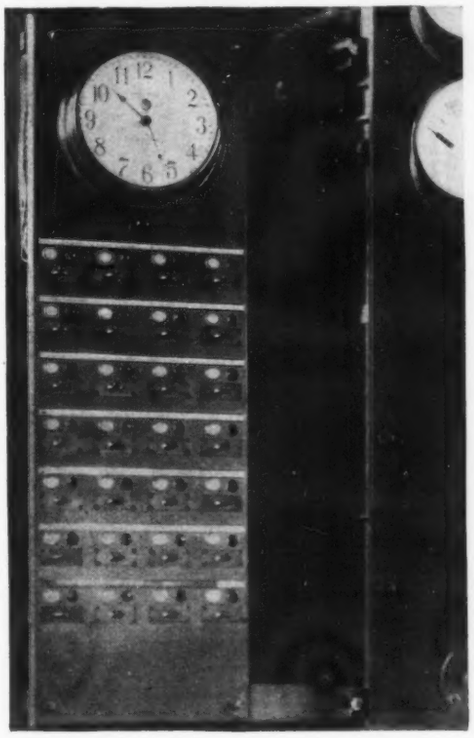
It is impossible to set up any sharp dividing line as to when electricity should be purchased or under what conditions it should be generated. Each individual plant offers a separate and distinct problem. Operating costs, fuel costs, purchased power costs and the amount of investment must be carefully studied. It is obvious that on plants where the management requires a large percentage of return on the investment the odds in favor of purchased current are increased. However, when the market price of steam and electrical generating equipment, as well as fuel prices, is at a low level, then we have a condition which strengthens the possibilities for generating on the isolated plant.

I believe that every plant is certainly a potential customer of the public utility company and if attractive rates are offered that the steam balance should be solved in such a way as to utilize the service of the public utility companies.

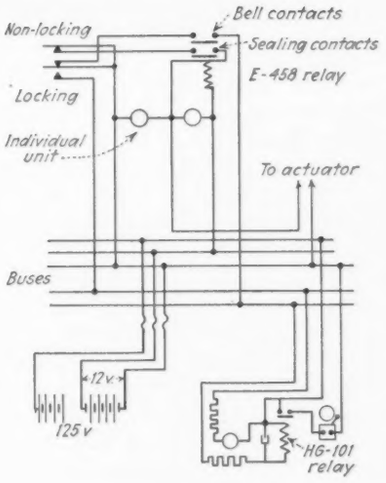
Annunciator Assembly Using Telephone Apparatus

By H. P. CURRIN
Electrical Engineer Eugene Water Board, Eugene, Ore.

As part of the layout of a hydro plant switchboard the problem arose of designing an annunciator to indicate any unusual condition that should be brought to the operator's attention. This included automatic circuit breaker operation, high bearing temperatures, stoppage of bearing or transformer cooling water and many other abnormal conditions that might occur. Something more compact than the usual devices made for this purpose was desired and it was decided to assemble an annunciator from standard power and telephone switchboard devices.



Compact and inexpensive annunciator harmonizes with main switchboard



Connections for individual annunciator units using telephone parts

Each of the 28 units necessary consists of a No. 479 telephone key with a locking and a non-locking position, a 2F, 12-volt switchboard lamp with socket and red lens, an Edwards Dixie No. 620 pushbutton for testing the circuit to each unit and an E458, 1,000-ohm telephone relay. This relay operates on a normal current of 0.011 amp., requiring 11 volts. In addition to the 28 units there is a 125-volt switchboard supervisory lamp, a General Electric HG 101 bell relay with a 500-ohm resistor, a 2-mfd. condenser and a 125-volt bell. Connections for each unit were as shown by the accompanying diagram.

The station control battery was tapped at the sixth cell from the end to provide current for the relays and lamps rather than to install separate resistors to reduce the voltage to 12 for each unit. The other apparatus is connected acoss the whole battery and has no tendency to run down individual cells. The assembly as a whole is interlocked to avoid incorrect indications and confusion of the operator. Cost of the panel installed, including labor and material, was $315.90. As shown by the accompanying illustration, the annunciator panel presents a neat appearance and harmonizes with the main board.

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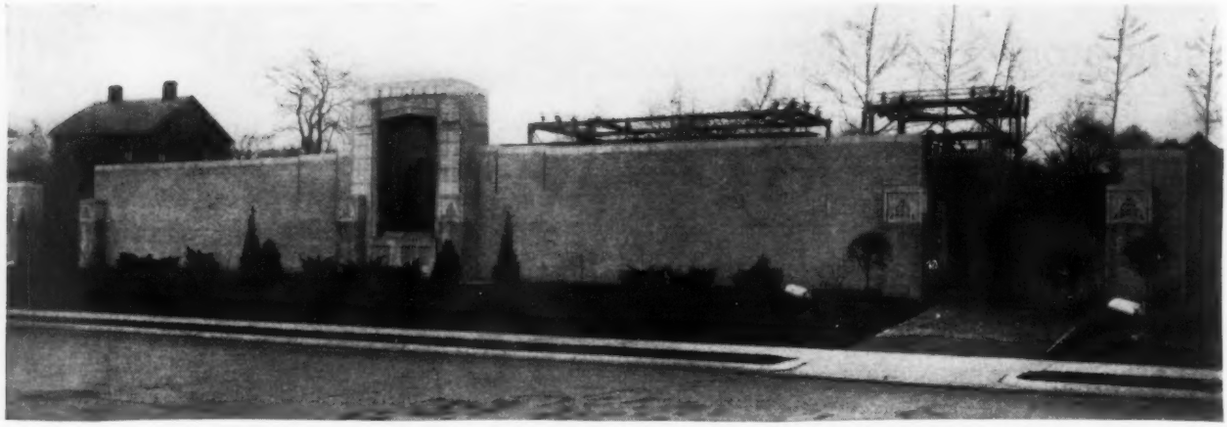
$400,000,000 in British Electrical Products

Six years' progress in electrical manufacturing in Great Britain is revealed by the British Census of Production just issued for 1930, with corresponding data for 1924.

The value of products increased from £61,630,000 ($300,000,000) to £71,827,000 ($349,000,000). The 1930 returns are not strictly comparable with those for 1924 because they exclude, for example, the output of firms employing fewer than ten persons and the production of electrical goods by trades, such as the automobile industry, reported separately. Allowing for these discrepancies, the value for 1930 becomes £81,000,000 ($394,000,000).

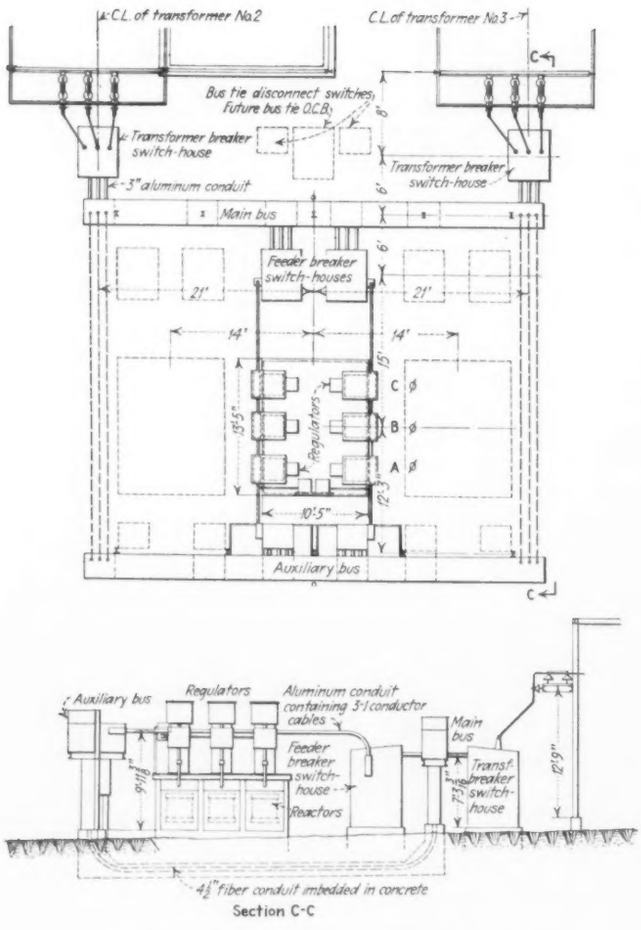
Adding production represented by allied electrical machinery such as steam turbines, condensers, etc., the values for the two years become respectively £74,000,000 ($360,000,000) and £95,000,000 ($462,000,000). At 1924 prices the latter is equivalent to £111,000,000 ($540,000,000), representing a quantitative increase of approximately 50 per cent. Meanwhile the capital invested, about £105,000,000 ($510,000,000) in 1930, is estimated to have increased only 12 to 15 per cent.

Average employment in the purely electrical trades, excluding machinery, was 180,820 persons in 1930 and 150,610 in 1924. In view of the fact that the average of unemployment in this field was 4.6 per cent in 1924 and 9.2 per cent in 1930, the increase in employment capacity is estimated around 35 per cent. Excluding administrative staff, and expressed in terms of the 1924 price level, production increased from £272 ($1,320) per worker in 1924 to £311 ($1,520) in 1930.



Appearance, Reliability, Economy Combined in Substation Design

By F. S. BROWN
Electrical Engineer of Stations
Byllesby Engineering & Management Corporation
(Pittsburgh Branch)



Layout of equipment provides for growth

NEW developments from the point of view of economical engineering design, general appearance and public relations are to be found in the new Sewickley substation of the Duquesne Light Company. The economical design of this station is the direct result of a study made to determine how a saving in the capital cost of substations could be secured without sacrifice in reliability and without an unwarranted increase in operating or maintenance costs. The architectural treatment of the exterior property wall is novel and produces a pleasing impression.

Transmission voltage is 22 kv. and distribution voltage is 4 kv. Both 22-kv. and 4-kv. circuits are in a region of overhead distribution, but enter and leave the substation via underground cables. Automatic reclosing equipment is installed and the station is unattended. The principal features of the design are:

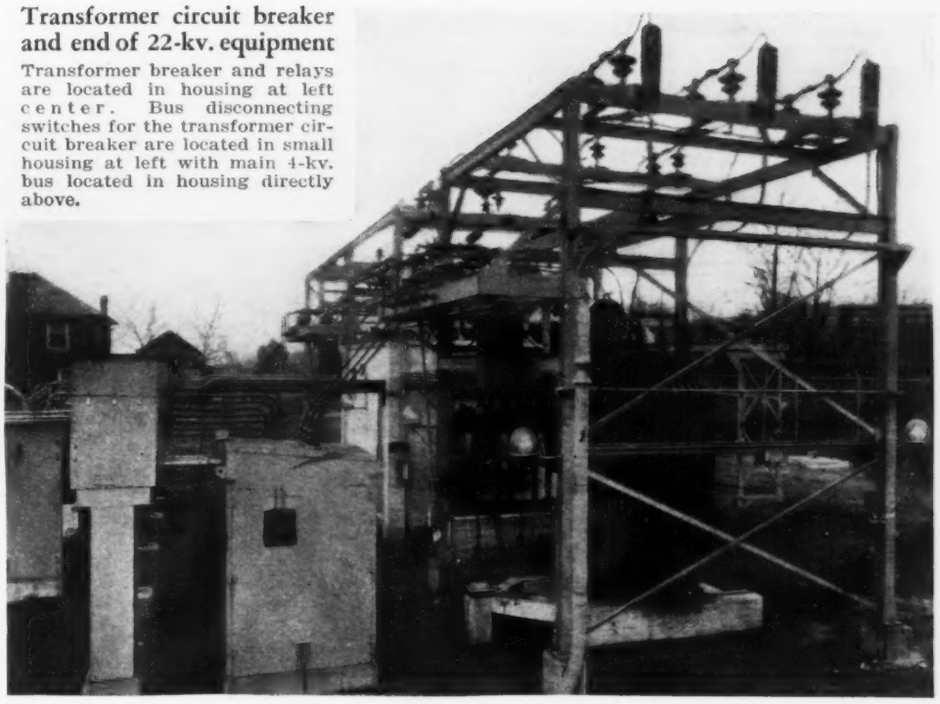
Elimination of substation building.
Novel architectural treatment.
Simplicity of layout.
Unit arrangement.
Isolation of equipment.

In the type of station previously used the transformers and 22-kv. equipment were located outdoors and the 4-kv. equipment was located in a building. At Sewickley all of the equipment has been located outdoors with the exception of a small amount of relaying and metering equipment, together with equipment necessary for the

operation and maintenance of the station, which has been installed in a small brick control house. Two three-phase transformer units and two 300-amp., 4-kv. feeders have been installed as an initial step, but there is sufficient space to allow for an extension to the three transformer units and ten 4-kv. feeders. On certain important 4-kv. connections aluminum conduit has been employed.

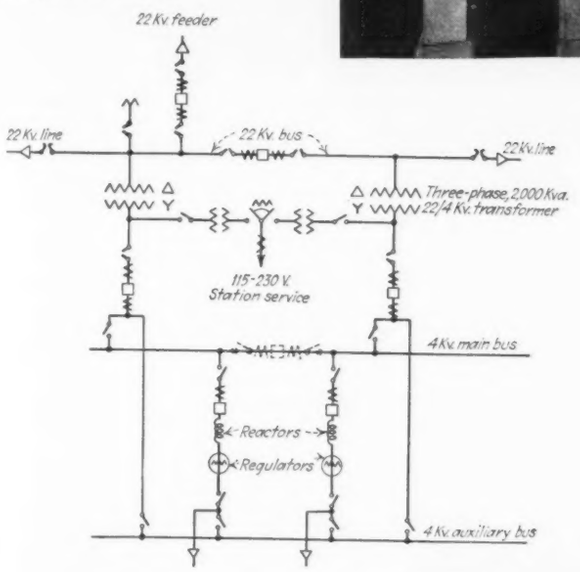
Transformer circuit breaker and end of 22-kv. equipment

Transformer breaker and relays are located in housing at left center. Bus disconnecting switches for the transformer circuit breaker are located in small housing at left with main 4-kv. bus located in housing directly above.



Switching facilities are simple yet flexible

Use of 22-kv. circuit breakers is minimized, yet every piece of equipment can be maintained without interruption to service.

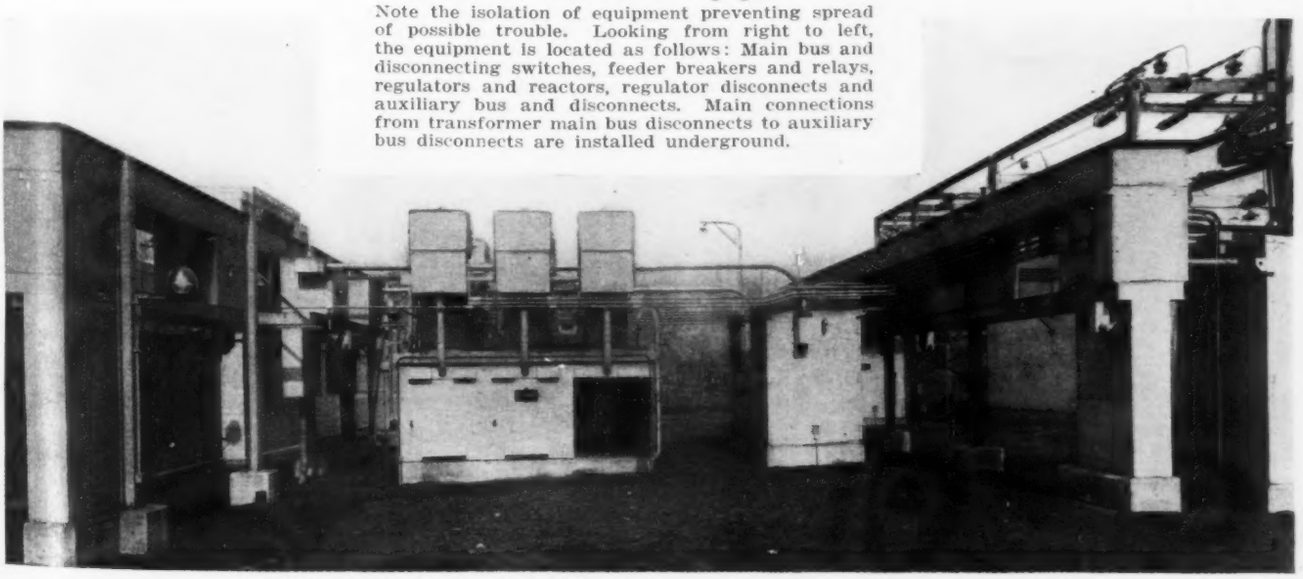


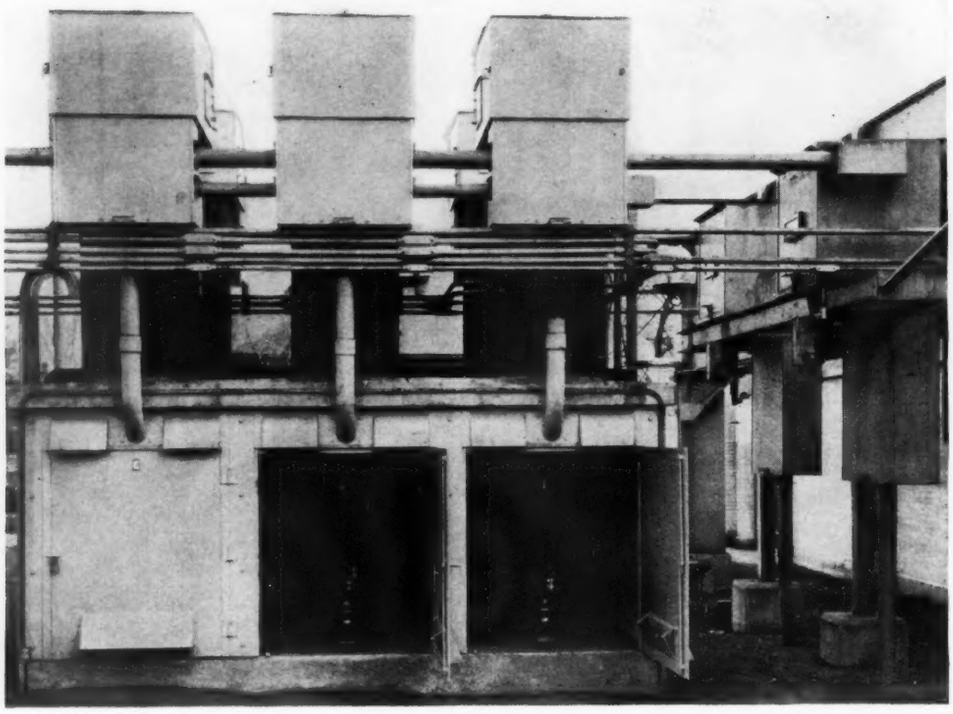
This type of station has the following advantages:

1. Low first cost when compared with previous type with 4-kv. equipment housed.
2. Space requirements small for an outdoor layout.
3. A small initial installation may be made and added to on a unit basis, eliminating the initial investment for a building large enough to house future feeders.
4. Possibility of trouble due to interference from an outside source is minimized.
5. Possibility of damage to adjacent equipment due to a failure is reduced as all 4-kv. equipment is outdoors and inclosed in individual steel housings.
6. The 4-kv. equipment is particularly safe to maintain as it is completely inclosed.
7. Maintenance costs are estimated to be lower than for an installation located in a building since janitor work and building maintenance is practically eliminated.

General view of 4-kv. equipment

Note the isolation of equipment preventing spread of possible trouble. Looking from right to left, the equipment is located as follows: Main bus and disconnecting switches, feeder breakers and relays, regulators and reactors, regulator disconnects and auxiliary bus and disconnects. Main connections from transformer main bus disconnects to auxiliary bus disconnects are installed underground.





Regulator and reactor structure

Standard indoor reactors are used. Concrete structure housing reactors requires little maintenance. Note screened openings for ventilation in reactor cell doors. Main connections are carried in aluminum conduit. All conduit is overhead, facilitating additions and changes. Regulator disconnects are located in steel housing to right of regulators. Outgoing cable terminals are located in steel housing below disconnects.

8. The maximum height of 4-kv. equipment is about 12 ft. This low elevation greatly facilitates inspection, cleaning and maintenance and results in a better appearance than for equipment mounted at a greater height.

9. The individual units can be arranged in various ways to best suit the dimensions and surroundings of the property under consideration without appreciable increase in cost or delay in producing construction drawings. As the station is unattended, remote indication provides the following information in the system operator's office, which is about 12 miles away:

1. Operation of:
(a) Outgoing 22-kv. feeder breaker.
(b) 22-kv. bus tie breaker.
(c) 4-kv. transformer breakers.
(d) 4-kv. feeder breakers.
Under "c" and "d" no indication is given as to which breaker has operated.

2. Failure of voltage on main 4-kv. bus.

Failure of control voltage.

Excessive temperature in transformers.

There is but one indication for the above three items as it is necessary in any case to go to the station to correct the trouble.

At Sewickley it was found advisable to provide a decorative, floodlighted wall to reduce the visibility of

A group of six single-phase regulators for two feeders

Relays and operating mechanisms are readily accessible. Angles are installed on floor to prevent spread of oil to regulators of other circuit in case of regulator failure.

the outdoor equipment. This was described and illustrated on page 418 of the February 28, 1931, issue of the ELECTRICAL WORLD. In some locations special architectural treatment will be unnecessary, while in others an ornamental iron fence with small trees and shrubs will be satisfactory.

The actual construction costs of the Sewickley substation show the savings estimated for this type of station to have been fully realized. Compared with its predecessor, a station of similar capacity, in which the 4-kv. equipment had been installed in a building, this station, including its decorative wall, has a cost of 88 per cent, against a cost of 100 per cent for the previous design. Without the wall its cost is 81 per cent.

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Testing and Using Radio-Interference Choke Coils

By B. E. ELLSWORTH

Iowa-Nebraska Light & Power Company, Lincoln, Neb.

Properly designed radio-frequency choke coils will stop a high percentage of radio interference from traveling along a transmission line or distribution feeder. A single-phase line will require two coils and a three-phase line three coils inserted in the line wires.

The interference graph shows the result of installing three such chokes in a branch line of 6,600 volts. The chokes were cut in at a point where there were no telephone line parallels to by-pass the choke. Insulators were cut in the wires of a fence which paralleled the line at the place where the chokes were installed. The effect of these could not be detected at the town, 6 miles distant.

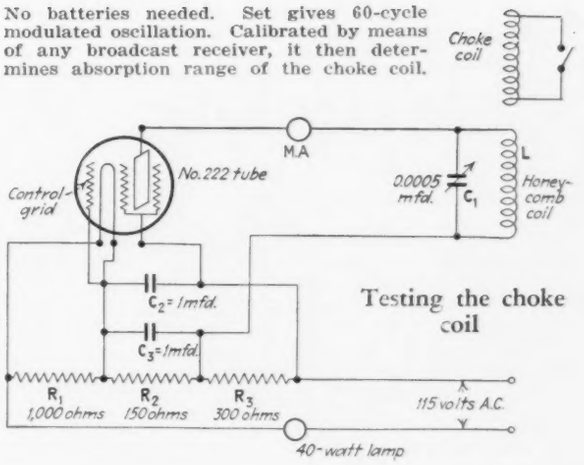
The coils are so constructed that their frequency response is between 700 and 1,000 kilocycles, or approximately in the center of the broadcast wave band. In the case cited above a 650-kilocycle choke coil would be the most effective.

A choke cannot be made by simply winding a coil of wire in a haphazard manner and expect it to work efficiently. The pancake or flat wound helix, so familiar to old wireless fans, has the desired characteristics. The flat ribbon used makes a very high capacity between the turns of the coil. Such a choke coil should have the following approximate dimensions:

Three-quarter-inch copper ribbon is wound on a 4-in. form with one layer of varnished cambric tape for insulation between each turn of copper; 1-32d-in. ribbon will give a coil which will carry 30 amp. Heavier copper can be used for coils which will be called upon to carry larger currents and vice versa. The tape should be a little wider than the copper ribbon, so the edges of the ribbon will not touch, and thus short-circuit a turn of the coil. From 75 to 85 turns will be found to give approximately the coil desired. The coil must be baked in compound to keep out moisture and hold together.

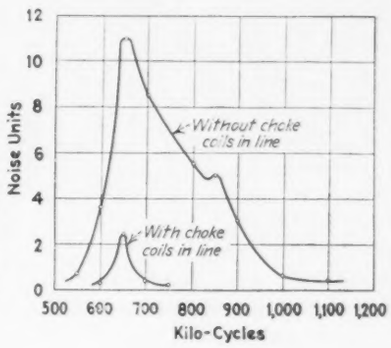
Each coil should be tested to be sure its natural frequency is between 700 and 1,000 kilocycles or any special frequency desired. Due to difference in tape thickness and also to the method of winding and baking, this frequency will vary somewhat for a given number of turns. The test described here, or an equivalent test, can be used to determine the natural frequency of the coil. The completed coil can be mounted between paraffin-treated wooden supports and suspended from an insulator under a crossarm. It can easily be cut in to the circuit with this system of mounting. There are many ways of testing the natural frequency of a coil. The following method is perhaps the simplest and requires the least equipment:

No batteries needed. Set gives 60-cycle modulated oscillation. Calibrated by means of any broadcast receiver, it then determines absorption range of the choke coil.



Interference is reduced

The town where the interference was measured is 6 miles from the point where the choke coils were installed in the 6,600-volt branch where it is tapped off the main line. Readings obtained from the milliammeter in the speaker circuit of a superheterodyne receiver.



The wave produced by a "Dynatron" oscillator is modulated by the 60-cycle a.c. and will produce a note in a radio set for a considerable distance. The resistors should be at least seven-watt capacity. Tubes vary a little and it may be necessary to connect the common point of the two condensers and the control grid connection to the other side of the filament. The milliammeter has a one milliampere scale.

By listening to the "Dynatron" output to a nearby radio set and varying the timing condenser, C_1, the 60-cycle note will be heard when the radio set and tube are in tune. By noting the wave length of the radio set at different condenser settings the condenser (C_1) can be calibrated in meters or kilocycles.

The method of determining the natural frequency of the choke coil is then to bring it within 2 or 3 in. of the coil L, keeping the distance between them constant. Take the reading of the milliammeter before and after closing the short-circuit switch across the choke coil. Subtract the two readings and call the difference the absorption effect of the choke coil.

By varying the condenser C_1 over the broadcast range and noting the differences in meter readings a curve can be plotted with kilocycles as abscissas and the difference of the milliammeter readings as ordinates. This curve will peak at the natural frequency of the choke coil. The flatness of this curve will depend somewhat upon the distance between the choke and the coil, L; however, the peak will always be at the same frequency.

These choke coils can be used in distribution systems to clear up a part of a city which is fed from a noisy primary circuit. The coil can also be installed in series street light circuits to stop the spread of radio interference. The size of coil mentioned above has a low resistance, the ribbon being larger than No. 6 wire. The voltage drop across its terminals is small.

Electrolytic Winning of Copper Advanced by Cheap Power

By WILLIAM E. GREENAWALT*
Engineer and Metallurgist, Denver, Colo.

WITHIN the past quarter century the metallurgy of the non-ferrous metals has been greatly changed and in some instances revolutionized. Both pyrometallurgy and hydrometallurgy have made wonderful strides, but there is no reason to believe that the limit of economy has been reached. So far the developments seem to have favored the dry methods, but it is by no means sure that this advantage will be held indefinitely. The enlargement of reverberatory furnaces in copper smelting, the generation of power from the excess heat and, recently, the wide application of natural gas to copper-smelting operations have apparently placed pyrometallurgy in a secure position for the present and for the indefinite future. On the other hand, hydrometallurgy has advanced with rapid strides and has latent possibilities which may in a few years make it a serious competitor of smelting and may ultimately dethrone it as a major operation.

The outstanding factor in the application of hydrometallurgy is the availability of cheap power at highly advantageous points and its effective transmission over long distances. Power costs have been greatly reduced during the past quarter century. The transmission of power over long distances, while greatly improved within the past quarter century, is still the outstanding problem in connection with cheap power; 300 miles is within effective transmission range, with a transmission loss of about 12 per cent. Mines and metallurgical plants are usually unfavorably located in reference to fuel and transportation.

In leaching and electrolysis the power used is closely proportional to the metal deposited, whereas in electric smelting the power used is more or less independent of the metal content of the material smelted. For example, in treating a 1.5 per cent copper ore containing appreciable values in gold and silver the power cost for 21 kw.-hr. to deposit 30 lb. (13.6 kg.) of copper, with the cost of power at 0.35 cent per kilowatt-hour would be 7.4 cents; the power cost for electric smelting, on the basis of 7,200 kw.-hr. per ton, would be $2.50. In addition there would be a carbon or graphite electrode consumption of 4 lb. (1.8 kg.) per ton of ore smelted, whereas the electrode consumption in depositing 30 lb. (13.6 kg.) of copper from leach solutions would be practically negligible. With power cost at 0.5 cent per kilowatt-hour, the power cost for depositing 30 lb. (13.6 kg.) of copper would be 10.5 cents, as compared with $3.60 for electric smelting. With a 25 per cent copper concentrate and a power cost of 0.35 cent per kilowatt-hour the power cost of depositing 500 lb. (227 kg.) of copper would be $1.75, and with power at 0.5 cent per kilowatt-hour the cost would be $2.50. The power cost for electric smelting would remain much the same as for the low-grade material. Leaching and electrolysis would give the copper as pure electrolytic metal; electric smelting would give the copper in the form of matte or blister.

Excerpts from paper (No. 61-29) presented at recent meeting of the Electrochemical Society in Baltimore.

Power cost is small part of total

If, therefore, large power plants are installed at coal mines and labor-saving devices are used in mining and burning the coal, the power cost in electrolytic processes, instead of being a controlling factor, may become surprisingly small. Water power, coupled with its economic transmission, is also a factor which will have to be reckoned with in the future. The tentative selling price of Hoover Dam power is 0.163 cent per kilowatt-hour. To this must be added the amortization of about $20,000,000 machinery investment and the cost of operating the hydro-electric plant. The total cost of the power at the dam will probably be from 0.175 cent to 0.18 cent per kilowatt-hour. It is probable that other hydro-electric plants, equally or more favorably situated, such as that of the Hudson Bay Mining & Smelting Company, can produce power approaching this figure. The cost of Coolidge Dam power is 0.5 cent per kilowatt-hour delivered at Hayden and 0.35 cent per kilowatt-hour delivered at Ray. Most mining sections in the United States could be made tributary to some source of cheap power within a radius of about 300 miles, although this is not an arbitrary limit. Large uniform loads for the full 24 hours per day, necessary in electrodeposition, is a favorable factor in the production and transmission of cheap power. The advantages of the transmission of cheap power, as compared with the transportation of ore and fuel for smelting, must be evident.

It seems highly probable that the relation between the wet and dry methods will be much more closely interwoven in the future than they have been in the past, with the wet methods in the major rôle.

By leaching with ferric solutions electrodeposition of the copper is desirable, perhaps imperative, and in the electrodeposition of the copper with the simultaneous regeneration of ferric iron only about half the amount of copper is deposited per kilowatt-hour that is deposited from iron-free or from effectively reduced solutions.

Fine crushing for leaching by percolation takes about 2.0 kw.-hr. per ton and fine grinding for flotation an additional 7.0 kw.-hr.; this difference in power cost, with power at 0.35 cent per kw.-hr. would be about 2.5 cents per ton. The total difference between fine crushing for percolation and the total milling cost, including fine grind-

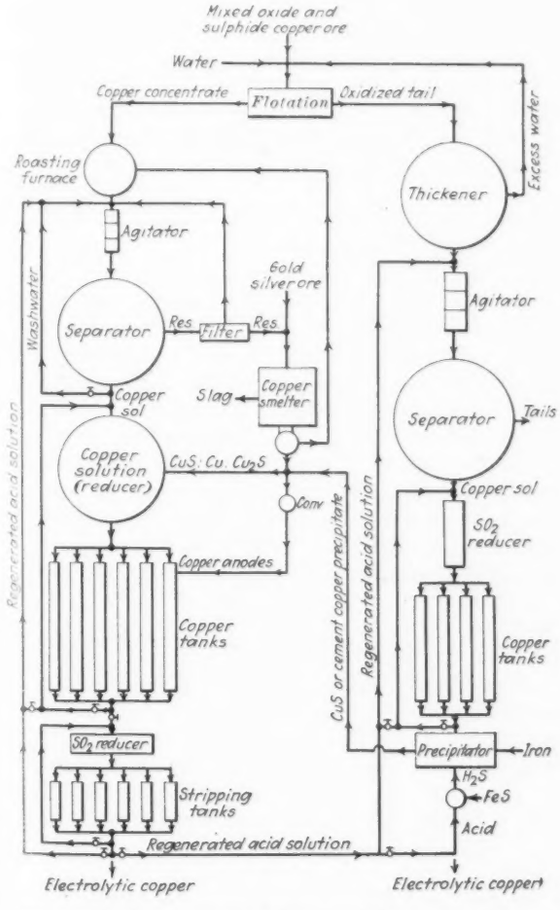
ing, flotation and dewatering the mill tailing, should not exceed 20 cents per ton, and this difference would at once be wiped out by an additional saving of 2 lb. (0.9 kg.) of copper, at the normal price of copper.

Iron complicates the process

In leaching siliceous mixed copper ore with a ferric solution there is no advantageous relation between the sulphide and oxide minerals and the ferric solution. The leach solution cannot conveniently be built up in soluble iron from the ore, for the reason that other impurities, especially aluminum, also accumulate, which makes the solution inefficient for leaching purposes. The iron in the ferric leaching solution is usually obtained by precipitating a relatively large portion of the copper with metallic iron. The precipitate is in the form of impure cement copper, and the iron goes into solution in the ferrous condition, which then has to be oxidized either chemically or electrolytically to the ferric state before it becomes available as a leaching agent for either sulphide or oxide copper. The resulting cement copper has to be given further treatment, either by re-solution and electrolytic deposition or by smelting, sometimes with the concentrates, and the ordinary electrolytic refining. The necessity of a high ferric content in the leach solution to dissolve the sulphide copper and permitting the ferric iron to increase in the electrolytic tanks in the deposition of the copper to produce such a solution are not complementary but antagonistic steps, which require a delicate balance and necessitate the loss of efficiency. If the ferrous iron is oxidized electrolytically to the ferric condition in amounts sufficient to make an effective solvent for the sulphide copper only about 0.65 to 0.75 lb. (0.29 to 0.34 kg.) of copper is deposited per kilowatt-hour, as against a practical 1.4 lb. (0.63 kg.) with pure or with effectively reduced solutions. This means a correspondingly larger plant and almost double the power required for the deposition of the copper, with a correspondingly increased cost of production. In addition, a large amount of the copper has to be precipitated as cement copper, as with metallic iron, and this involves large extra expense for the iron and for the treatment of the resulting cement copper.

If the mixed ore is treated by the method involving flotation, either before or after leaching, the process has a wide range and there is a close and advantageous relation between the various steps; the maximum extraction of both the sulphide and oxide copper is obtainable, no matter what their relative proportions may be or the mineralogical form of the copper minerals; the deposition of the copper from the leach solutions is highly efficient and the electrolysis is reduced to its ultimate simplicity; the amount of cement copper is relatively small, and the solvent for the copper—the regenerated acid solution—is supplied at practically no additional cost of either installation or operation over that required to deposit the copper. All of the copper is obtained as electrolytic metal. If the ore contains precious metals it is believed that they can be recovered as advantageously—perhaps more advantageously—by the method involving leaching and electrolysis than by the present method of smelting and electrolytic refining. If mixed ore containing precious metals is leached with a ferric sulphate solution the precious metals, associated with both the oxide and sulphide copper, are necessarily lost, and chloride solutions, as a possible alternative, have peculiar difficulties of their own. By the proposed scheme, if the ore contains precious metals worth recovering, the gold and silver associated with the sulphides will be concentrated in at least the same proportion as the copper.

Apparently, in the present state of copper extraction from mixed ores, such as those occurring in large quantities in the western part of the United States, Africa and elsewhere, the most promising procedure is that of fine grinding, flotation to separate the sulphide concentrate from the oxide tailing, roasting the concentrate to make the major portion of the copper water soluble, electrolyzing the resulting rich and relatively pure copper solution to deposit the copper as the electrolytic metal with the simultaneous regeneration of an equivalent of acid, and leaching oxidized copper ore or oxidized flotation tailing with the excess regenerated acid solution.



Electrolyzing copper when precious metals are absent from ore

Separating copper in precious metal ores

For illustration of the treatment of mixed copper ore, free or practically free from gold and silver, assume a unit capacity of 100 tons of mixed copper ore per day, containing 1.5 per cent recoverable copper, or a total of 3,000 lb. (1,360 kg.). If the ore is ground to 48 mesh and subjected to flotation the following results may be assumed:

92 tons tailing, 0.25 per cent copper (5 lb. [2.27 kg.] per ton)	460 lb. (209 kg.)
8 tons concentrate, 15.875 per cent copper (317.5 lb. [144 kg.] per ton)	2,540 lb. (1,152 kg.)

The 8 tons of medium grade concentrate may be separated into:

1.5 tons of 50 per cent concentrate (1,000 lb. [454 kg.] per ton) ..... 1,500 lb. (680 kg.)
6.5 tons of 8 per cent concentrate (160 lb. [73 kg.] per ton) ..... 1,040 lb. (462 kg.)

The high-grade and the low-grade concentrate are roasted separately, either in the same or different furnaces. If the roasting is properly carried out from 75 to 85 per cent of the copper can be made soluble in water, as the sulphate, and from 95 to 98 per cent can be made soluble in dilute acid. The low-grade concentrate is roasted with the object of getting the highest ultimate extraction, irrespective of the amount of soluble iron. The high-grade concentrate is roasted so as to give the desired proportion of copper oxide and copper sulphate for later use in the process.

The low-grade concentrate is leached by agitation with the amount and strength of acid solution for a sufficient time to give the desired extraction of the copper. The resulting acid copper solution, containing salts of iron, is separated from the residue and washed only enough to replace, with the richer washwater, the amount of solution lost and discarded in the leaching and electrolytic circuit. No care need be taken to get clear solutions. Such a separation of the liquid from the residue is cheaply made and will remove most of the soluble copper. The residue, only partly washed and as a pulp which is easily pumped, is transferred to the partly dewatered oxidized flotation tailing and treated with it.

Low- and high-grade concentrates mixed

The crude copper solution obtained from leaching the low-grade concentration, containing salts of iron and other impurities in solution and possibly small particles of insoluble matter in suspension, is then treated with the roasted high-grade concentrate and agitated with air. The high-grade concentrate is preferably roasted so as to give the right proportion of copper oxide and copper sulphate, so that the sulphate will go into solution and the oxide will be in sufficient excess to neutralize the copper solution and precipitate iron and other impurities. Other reagents, such as limestone and manganese dioxide, may be used in small amounts to assist the precipitation of the impurities. The precipitation of the iron need not be complete. Refinements are unnecessary. A small amount of copper is usually precipitated with the iron or entrained in the precipitate.

The resulting copper solution may be made as rich in copper as desired, below the point at which copper sulphate is likely to crystallize. It will ordinarily range from 5 to 8 per cent copper. The copper is deposited from this rich and relatively pure solution with a high ampere efficiency and with a power expenditure of about 0.71 kw.-hr. per pound (1.56 kw.-hr. per kilogram) of copper deposited. The cathodes are of exceptional purity. From 90 to 95 per cent of the copper in the concentrate may be produced in this form.

The filtered residue, consisting of partly leached high-grade concentrate and precipitated impurities, is treated to separate the precipitate from the residue. This may be done by applying regenerated acid solution to the residue. The soluble precipitate, consisting mostly of iron salts, is quickly dissolved, as is also the soluble entrained copper. A small amount of undissolved copper will also go into solution, but this can be regulated as desired. The high-grade concentrate on roasting and leaching will shrink about 80 per cent in weight, and assuming an extraction of 95 per cent, the residue will assay about 12.5 per cent copper, or not a great deal more than the raw low-grade concentrate. This residue is added to the raw low-grade concentrate to pass through another cycle and is thus given a complete additional treatment at a minimum expense. The ultimate extraction of the copper from the high-grade concentrate is exceptionally high, closely approximating 100 per cent. The impure solution obtained from dissolving the precipitate from the residue, containing excess acid, a small amount of copper and a large amount of iron, is added to the head leach solution for extracting the oxidized copper from the mill or flotation tailing.

Two electrolytic circuits in parallel

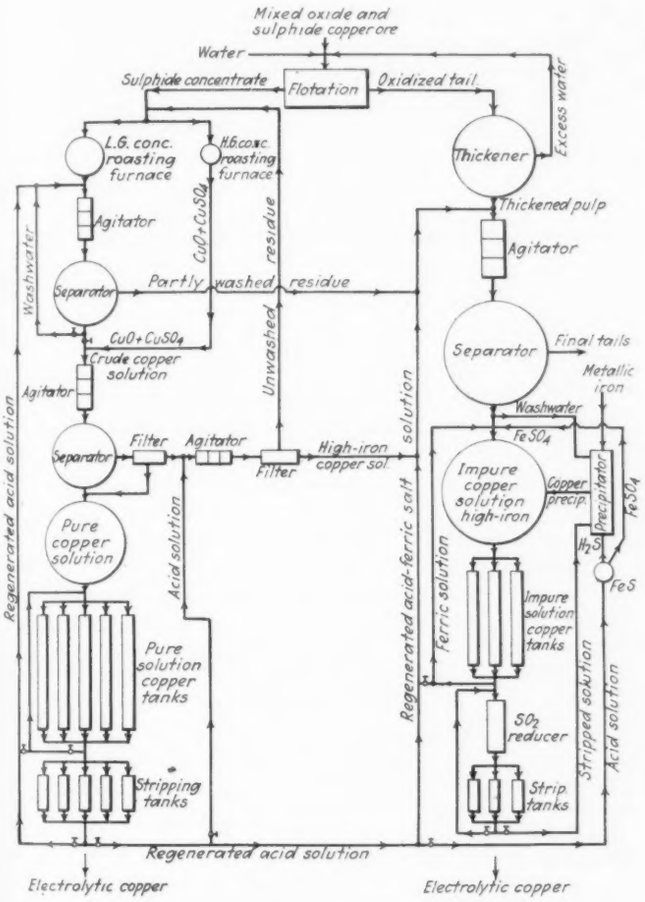
It is preferred to maintain two electrolytic circuits—one, the pure copper solution circuit through which the greater portion of the copper is produced; the other, an impure copper solution through which the smaller amount of copper is produced. The pure copper solution is maintained high in copper and low in iron; the impure copper solution is maintained low in copper and high in iron, but the copper in the impure solution should be high enough to make effective electrodeposition of the larger portion of the copper practical. The acid in the impure copper solution circuit is always low, and this is desirable because the ferric iron produced in the deposition of the copper is more readily reduced in a low-acid than in a high-acid solution.

The impure copper solution is preferably electrolyzed with graphite anodes. By using graphite or carbon anodes ferric iron rather than acid is regenerated and the ferric iron so produced can be used to work up into electrolytic metal all of the chemically precipitated copper and, if necessary, some chalcocite from the high-grade concentrate. The resulting electrolytic copper, excepting that produced in the stripping tanks, is of high purity. The iron does not appreciably affect the purity of the deposited copper, and injurious impurities, such as arsenic, antimony and bismuth, are not likely to accumulate in sufficient amounts to affect the cathodes greatly. Aluminum, which is usually a major impurity in leaching crude copper ores, is present only in small amounts in leaching roasted concentrate. It accumulates in leaching the mill tailing. The impure cathodes produced in the stripping tanks are transferred to the pure copper solution circuit as anodes and refined. The arrangement described permits of the wasting of a large amount of tail solution from the impure copper solution circuit and the solution may be kept at any desired standard of impurity.

Graphite anodes demand depolarization

If graphite anodes are used in depositing the copper from the impure solution effective reduction and effective depolarization are necessary. Effective depolarization is accomplished by maintaining a warm electrolyte, a low current density, vigorous circulation and a relatively high amount of ferrous iron in the electrolyte. Effective reduction of the ferric iron is accomplished by means of copper sulphide precipitate, cement copper, chalcocite or sulphur dioxide—all cheap reagents and all of which react favorably both for electrolysis and reduction. A low current density is in harmony with a low-copper elec-

trolyte, hence there is no advantage in maintaining a high copper content in the impure solution circuit and thus complicating both the leaching and the washing of the oxidized mill tailing. Experience will determine the best amount of copper for the impure solution for each particular ore, but the copper could conveniently be maintained at about 1.0 per cent. If graphite anodes are used to deposit the copper from the impure, or high-iron, solution, the voltage and consequently the power is about half that when using lead anodes, depending somewhat



Getting copper by electrolysis from ores containing gold and silver

on the temperature of the electrolyte. In this way about 2.5 lb. (1.1 kg.) of copper can be deposited per kilowatt-hour, or about 0.4 kw.-hr. per pound (0.88 kw.-hr. per kilogram) of copper. If the cost of power is 0.25 cent per kilowatt-hour, the power cost for depositing a pound of copper is 0.10 cent (0.22 cent per kilogram); if the cost of power is 0.35 cent per kilowatt-hour, the cost of depositing a pound of copper is 0.14 cent (0.31 cent per kilogram). With lead anodes the cost would be almost twice these amounts.

The deposition of the copper from relatively pure or from reduced impure solutions is fairly simple and highly efficient. From 1.35 to 1.45 lb. (0.61 to 0.66 kg.) of copper per kilowatt-hour is usual. The deposition of copper from solutions containing salts of iron has always been the outstanding problem in depositing copper from leach solutions. If the copper is deposited with the simultaneous regeneration of enough ferric iron to make the ferric solution effective as a solvent for the sulphide copper the efficiency of the deposition is correspondingly lowered, depending on the amount of ferric iron in the electrolyte. From 0.65 to 0.75 lb. (0.29 to 0.34 kg.) of copper per kilowatt-hour may be considered good work. This difference in efficiency between acid and ferric leaching implies correspondingly increased installation, increased power and increased cost for ferric leaching.

The excess acid obtained from depositing the copper will usually more than pay for the power required to deposit the copper and regenerate the acid. The cost of acid, if manufactured or bought, will vary greatly, depending on the location of the acid plant. The market price for acid in car lots at the acid plants is usually about $10 a ton, to which must be added freight, and sometimes truck transportation. If the acid plant is installed at the mine the expense is considerable and the cost of manufacturing the acid may vary $10 a ton in small plants to $5 a ton and even less in large plants. Assuming a regeneration of 1.5 lb. of acid per pound of copper deposited, the relation of power cost and acid expense may be seen from the following table:

Cost of Power and Acid

Cost of Power per Kw.-hr., Cents	Power Deposition Cost per Lb. Copper, Cents	Acid Credit per Lb. Copper, Acid Cost $10 per Ton, Cents	Difference, Acid Credit, Cents	Acid Credit per Lb. Copper, Acid Cost $5 per Ton, Cents	Difference, Acid Credit, Cents
0.25	0.178	0.75	0.572	0.375	0.297
0.35	0.250	0.75	0.500	0.375	0.125
0.50	0.357	0.75	0.393	0.375	0.018
0.75	0.543	0.75	0.207	0.375	—0.168
1.00	0.715	0.75	0.035	0.375	—0.340

It will be observed that the acid credit, with acid at $5 a ton, will about cover the power cost for depositing the copper and producing the acid, when the cost of power is 0.5 cent per kilowatt-hour; if the power cost is 0.35 cent per kilowatt-hour, there would be a credit of 62 cents per ton on the treatment of 25 per cent copper concentrate. The acid credit, with acid at $10 a ton, will about cover the cost of copper deposition and acid regeneration when the cost of power is 1.0 cent per kilowatt-hour; if the power cost is 0.5 cent per kilowatt-hour, there will be an acid credit of $1.97 per ton of 25 per cent copper concentrate; if the power cost is 0.35 cent per kilowatt-hour, there will be an acid credit of $2.50 per ton of 25 per cent copper concentrate. These acid credits will go a long way toward covering the total treatment charge of the concentrate.

Power cost important with sulphide ores

If the ore is a sulphide and contains no precious metals the excess acid produced by leaching and electrolysis would have no credit value. The comparison would then be between leaching the roasted concentrate and electrolyzing the resulting copper solution, and smelting, converting and electrolytic refining. Leaching of a fairly high-grade concentrate is not expensive. The principal adverse factor in leaching and electrolysis, as compared with electrolytic refining, is the difference in the voltage and hence in the power. About 1.4 lb. (0.64 kg.) of copper is deposited per kilowatt-hour in copper deposition and about 7 lb. (3.17 kg.) is deposited per kilowatt-hour in electrolytic refining. The cost of power, therefore, is an important item, and while the difference is comparatively small for cheap power, it

becomes an item of importance when the power is expensive, as will be seen from the following table:

Cost of Power per Kw.-Hr. Cents	Power Cost for Electrolysis — Deposition Cents per Pound	Refining Cents per Pound	Difference Cents per Pound
0.25	0.178	0.036	0.142
0.35	0.250	0.050	0.200
0.50	0.357	0.072	0.285
0.75	0.543	0.107	0.436
1.00	0.714	0.143	0.571

These power costs for copper deposition include the regeneration of acid to leach the copper from the roasted concentrate at no additional acid expense. With power at 0.35 cent per kilowatt-hour the difference per pound of copper between deposition and refining is 0.2 cent; with power at 0.5 cent per kilowatt-hour the difference is about 0.3 cent. On the other hand, the labor cost for deposition with insoluble anodes, which are reasonably permanent, is less than for soluble anodes, which have to be cast, inserted in the tanks and the unconsumed portion of the anodes removed, remelted and recast with new anode copper. In leaching there is no smelter dust or fume and cathode copper made at the leaching plant can be shipped direct to the consumer and thus save transportation charges to the refining plants, which are usually located at a considerable distance from the smelter. The amount of copper recovered from the ore will be about the same for leaching as for smelting.

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BOOK REVIEWS

American Electricians Handbook

By Terrell Croft. McGraw-Hill Book Company, New York, N. Y. 1017 pages, illustrated. Price, $4.

A wholly revised edition, the first since the second edition of 1921, with 200 pages of new material and 150 new illustrations, brings this practical man's handbook up to date, including its references to and dependence on the 1931 National Electrical Code. Raceways, crane wiring, new cost-estimating tables, illumination design tables are examples of the modernizing elements.

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Étude et Construction des Lignes Électriques Aériennes

By Ch. Lavanchy. J.-B. Ballière et Fils, 19 rue Hautefeuille, Paris (6e). 728 pages, 302 illustrations. Price, paper, 110 francs; bound, 125 francs.

This comprehensive treatise on transmission lines is in three major sections: The strictly electrical problem of the transmission of energy; the mechanical aspect, embracing forces acting on the conductors, pole and tower construction (riveted, welded, reinforced concrete), foundations; economic considerations. The formulas and methods of computation are elucidated with the aid of numerous illustrative problems. Graphical methods and charts are freely used throughout; tabular data on electrical and mechanical properties of materials make the work self-contained. The author is a specialist with wide experience in transmission engineering.

Element of Human Engineering

By C. R. Gow. Macmillan Company, New York. 169 pages. Price, $1.60.

Through building sewers, foundations, tunnels and army bases Colonel Gow acquired that wealth and depth of human appreciation which established him as the first occupant of the chair of humanics at M.I.T. This book amplifies its predecessor, "Foundations of Human Engineering," by multiplying the anecdotes which, far better than harangues, emphasize those psychological and psychic adjuncts of technical intelligence which make or break the cub engineer. Common sense is classified under the headings of impressionism, co-operation, discipline, modesty, sanity, ethics, sportsmanship and optimism. Interspersed is a bit of homely interpretation of the fundamentals of capital and labor as participants in production.

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Rewinding Data for Direct-Current Armatures

By G. A. Van Brunt and A. C. Roe. McGraw-Hill Book Company, New York. 208 pages, illustrated. Price, $2.50.

All electrical repair men are familiar with Mr. Roe's work and publications on induction motor windings. The same completeness has been carried by Messrs. Van Brunt and Roe into the field of direct-current armatures. No phase of their repair and rewinding seems to be omitted. While not intended as a text on design of armature windings, yet there is a description and analysis of the most complete collection of different types to be found anywhere. All ordinary lap and wave windings are covered and all variations likely to be met in practice are shown.

It is written specifically for repair shops doing rewinding and describes in full detail how to record the winding so that it can be exactly reproduced. There is a wealth of practical suggestion as to how the rewinding should be done. It is an essential and indispensable book for all repair shops.

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Municipally Owned Electric Utilities in Nebraska

By Paul Jerome Raver and Marion R. Sumner. Institute for Economic Research, 337 East Chicago Avenue, Chicago, Ill. 61 pages, illustrated. Price, $1.50

This comprehensive statistical and technological history of the municipal utility movement in Nebraska from 1886 to date covers the 170 surviving and the 308 initiated equally thoroughly. An effort is made to ferret the reasons for establishment of new ventures and also for their later abandonment; here local explanation is weighed for what it is worth. One can sense the trend adequately from the copious statistics.

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Bedarf und Dargebot

Demand and Supply

By Dr.-Ing. Adolf Ludin, Julius Springer, Berlin W9. 38 pages, 31 illustrations. Price, 6 reichsmarks.

From the comprehensive title through a more restrictive subtitle the monograph narrows down to a series of graphs derived from load curves, with an inadequate text.

Men of the Industry

J. P. Clayton Heads Illinois Utility

J. Paul Clayton has been elected president of the Central Illinois Public Service Company, to succeed Marshall E. Sampsell, who resigned as president of the company earlier in the year. Mr. Clayton was operating vice-president of the company for thirteen years until last January, when he was promoted to the office of vice-president in charge of operations of the Middle West Utilities Company, of which the Central Illinois company is a subsidiary. He is now continuing as a vice-president of Middle West Utilities.

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ABRAHAM WEBBER of Boston has been appointed by Governor Ely of Massachusetts as a member of the Department of Public Utilities to succeed Lewis Goldberg, whose term has expired.

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LEAVITT L. EDGAR, vice-president of the Edison Electric Illuminating Company of Boston, has been appointed regional director for New England of the National Electric Light Association Refrigeration Bureau, succeeding his father, the late C. L. Edgar.

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FRANK E. KRUESI, who has been identified with the Insull interests for a number of years, has been elected president of the Wisconsin Power & Light Company, Madison, Wis., to succeed Marshall E. Sampsell, who resigned earlier in the year. Grover C. Neff remains operating vice-president with headquarters in Madison.

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J. S. TRITLE has been elected vice-president in charge of operations of the Westinghouse Electric Supply Company, wholesale distributor of Westinghouse products to electrical dealers, contractors and industrial establishments. He will assume his new duties immediately in addition to his present position, vice-president and general manager of the Westinghouse Electric & Manufacturing Company.

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GEORGE F. OXLEY has resigned as director of information and service of the National Electric Light Association after twelve years of service at New York headquarters. Mr. Oxley entered the employ of the association March 1, 1920, as director of publicity under Merlin H. Aylesworth, then managing director of the association. He had previously been associated with Mr. Aylesworth in Denver as secretary of the Colorado State Public Utilities Commission when Mr. Aylesworth was its chairman. During the reorganization period of the association in the early 1920's Mr. Oxley assisted in the organization of several geographic divisions. He also took a leading part in organizing public utility information bureaus. Activities of the Public Relations National Section occupied much of Mr. Oxley's attention. All advertising and publicity activities of the association and all informational services have been directly under his supervision. Although he lived in the West a number of years before coming to the association, Mr. Oxley is a native of Massachusetts. He engaged in newspaper work in Massachusetts and in Denver, Colo., before joining the Colorado commission.

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Allis-Chalmers Elects New Officers

Otto H. Falk, president of the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., since 1913, has just been elected chairman of the board of directors of that company and Max W. Babb, vice-president, has been elected president to succeed him.

Mr. Falk has been an outstanding figure in the electrical manufacturing industry for a number of years, adding to his commercial leadership active participation in military and civic affairs. Twenty years ago, when affairs of the Allis-Chalmers Company became somewhat involved, Mr. Falk, who at that time had large financial interests in Milwaukee, was called upon to clear up the situation by the banks interested. In 1912 he was named receiver and upon reorganization a year later he was made president, the position he has occupied since that date. General Falk is a native of Wisconsin and after receiving collegiate training in Northwestern College he entered the Allen Military Academy of Chicago, from which he was graduated as ranking captain in 1884. A notable military career followed, and when he retired from the Wisconsin National Guard in 1911 it was with the rank of brigadier-general. For a long time he was president of the Merchants and Manufacturers' Association of Milwaukee, has been regent of Marquette University and fire and police commissioner of Milwaukee. On many important occasions General Falk has been a delegate to national conferences.

Otto H. Falk

Mr. Babb, the new president, has been a vice-president of the company since 1913 and at the present time is serving on the board of directors and as a member of the executive committee. A native of Mount Pleasant, Iowa, and a graduate of Iowa Wesleyan College and of the University of Michigan law department, he entered the practice of his profession in his native city with his father in the firm of Babb & Babb. In 1904 he moved to Chicago to become attorney for Allis-Chalmers. Mr. Babb is a director of the Federal Reserve Bank of Chicago. For eight years he was a director of the Chamber of Commerce of the United States, and for six years of that period was chairman of its finance committee.

Max W. Babb

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DR. F. HERBERT SNOW, chief of the bureau of engineering of the Public Service Commission of Pennsylvania, has retired after 27 years in the service of the state. Dr. Snow has been head of the engineering bureau since the formation of the commission in 1913. He attended public schools of Boston and Harvard University and the Massachusetts Institute of Technology. In 1890 he was appointed city engineer of

Brockton and later engaged in private practice as a member of the engineering firm of Snow & Barber, New York and Boston. In connection with his duties with the Public Service Commission he did extensive valuation work.

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JOHN W. MCCARDLE has been re-elected chairman of the Indiana Public Service Commission, this being his fourth term as president. He has been a member of the commission fifteen years, ten of which he has been president. The vote of his colleagues renaming him was unanimous.

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H. H. WATSON has been appointed general superintendent of construction of the Northern States Power Company with headquarters in Minneapolis. Mr. Watson for the past ten years has been in charge of the special construction department of the San Diego Consolidated Gas & Electric Company. GEORGE F. PHYTHIAN, who for several years has been in charge of construction work of the California Oregon Power Company and the Mountain States Power Company, will extend his duties to include the San Diego Consolidated Gas & Electric Company. These properties are under Byllesby management.

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W. CORNELL BLANDING, treasurer of Crouse-Hinds Company manufacturer of electrical equipment, has been elected a director of the Syracuse Chamber of Commerce.

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GUGLIELMO MARCONI was made the recipient of the Kelvin medal for 1932 by the Kelvin medal award committee of the Institution of Civil Engineers (Great Britain). The medal is awarded as a mark of distinction in engineering work and investigation of the kinds with which Lord Kelvin was especially identified.

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OBITUARY

Robert M. Feustel

Robert M. Feustel, president of the Midland United Company and head of the entire Insull group in Indiana, died at Fort Wayne, Ind., May 8, from an acute kidney infection. Mr. Feustel was also president of the Public Service Company of Indiana. He succeeded Samuel Insull, Jr., as president of the Midland United properties last December. Mr. Feustel was a native of Fort Wayne and received his bachelor of science degree at Purdue University in 1905 and that of civil engineer in 1909. At one time he was assistant chief engineer of the Wisconsin Railroad Commission, and later chief engineer and then consulting engineer of the Illinois Railroad Commission, holding the latter post until 1927. His work brought him into contact with public utility problems in most of the chief cities of the mid-West and East and in Canada.

Mr. Feustel left commission work in 1915 to engage in private consulting engineering, which he continued until 1929. In 1917 he was elected president of the Indiana Service Corporation, with headquarters at Fort Wayne, a position which he retained until his death. While thus actively engaged as a public utility operator Mr. Feustel served almost continuously during the next twelve years in consulting engineering and valuation work for both public bodies and public utility companies.

In 1929 Mr. Feustel was elected executive vice-president of the Midland United Company, which controls the Indiana Service Corporation and other companies operating in Indiana and Ohio. In the following year he was elected an officer of other subsidiary companies in the group. Recently he was elected president of the Midland United Company and a director of the Northern Indiana Public Service Company. Mr. Feustel was 48 years old.

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William A. Jackson

William A. Jackson, 65, vice-president of the Milwaukee Electric Railway & Light Company, Milwaukee, Wis., died at his home on Oconomowoc Lake April 28, following injuries sustained in an automobile accident in February. Mr. Jackson entered the public utility field in 1915 in St. Louis with the North American Company. A year later he joined the Milwaukee Electric Railway & Light Company as attorney and in 1922 became vice-president. During his connection with the Milwaukee company he was its legislative counsel and in this capacity became known throughout the state. He was also a vice-president of the Wisconsin Gas & Electric Company, Racine, and of the Wisconsin Michigan Power Company at Appleton. Mr. Jackson was born in Janesville, Wis., and was graduated in law from the University of Wisconsin in 1891. He practiced law in his native city and from 1895 to 1905 was District Attorney of Rock County. In 1905 he removed to Milwaukee and joined the law firm of Cary, Upham & Black, remaining until he became vice-president of what was known then as the Fidelity Trust Company of Milwaukee. He was in the securities business in Chicago from 1913 to 1915.

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ROY B. CHAMPION, Superintendent of Public Works, Holland, Mich., died April 21.

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WILLIAM H. HILL, superintendent of electrical construction for the New York Edison Company, died May 4, after a short illness, in his sixty-seventh year. Mr. Hill was born in Philadelphia and began work in the electrical industry with the General Electrical Company of Philadelphia. Removing to New York, he entered the employ of the old Edison Electric Illuminating Company, a predecessor of the New York Edison Company, in 1890, and he completed 42 years of service on April 23. He became superintendent of electrical construction in 1924.

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ALBERT E. DRENDELL, secretary-treasurer of the Decker Electrical Construction Company, San Francisco, died in that city April 25. He was the founder of the Drendell Electrical Manufacturing Company, which he later sold to the Trumbull Electrical Manufacturing Company, the local company now known as the Drendell-Trumbull Electrical Manufacturing Company. Mr. Drendell was not affiliated with it at the time of his death. He was a past vice-president of the San Francisco Electragists.

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B. W. GILSON, electrical superintendent of the Carnegie Steel Company, Youngstown, Ohio, died suddenly April 27. Mr. Gilson had been identified with the steel industry for more than 40 years. He was a native of Pennsylvania and a graduate of Hiram College. After five years' experience with other steel plants, Mr. Gilson became affiliated with the Ohio works of the Carnegie Steel Company at Youngstown, a connection he maintained until his death. He was a past-president of the Association of Iron and Steel Electrical Engineers.

Trade News

Inland Steel Company of Chicago announces the appointment of H. C. Darby as district sales manager at the Kansas City (Mo.) office. Mr. Darby has been a member of the sales force of the company continuously since 1926.

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Eagle Electric Manufacturing Company, Brooklyn, N. Y., announces that the new spring catalog is now available, featuring many additional new items. The items are grouped in sections for quick location. Full descriptions, packing, weights of standard packages and prices accompany each article.

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Lighting Appliance Company, Inc., of New York City, has decided to open a branch in Montreal, and for this purpose a Canadian company has been incorporated. The new company will be known as the Lighting Appliance Company of Canada. The company has leased considerable space in a building on Notre Dame Street East.

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Westinghouse Neon Company has been formed with a plant at Hamilton, Ontario. The company will manufacture all classes of neon displays, including improvements achieved by Westinghouse engineers. In addition to neon signs the company will produce other forms of display.

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James R. Kearney Corporation announces that Tom C. Clark has joined the sales organization as field contact engineer. Mr. Clark is particularly well known in the electrical field because of his prior connections. Mr. Clark received his education at Missouri University and Washington University. He was connected with the Union Electric Light & Power Company at St. Louis for many years in the estimating division of the electrical distribution department and also in the construction department as division superintendent.

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Burke Electric Company, Erie, Pa., well-known manufacturer of motors, generators and electric welders, announces the appointment of George Kuehnle, Jr., as general distributor for the Cincinnati district. Mr. Kuehnle is located at 1011 First National Bank Building.

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La Consolidada, S.A., of Mexico, one of the largest steel manufacturers in Mexico and the foremost advocate of arc welding in that republic, has been appointed Mexican distributor by the Lincoln Electric Company of Cleveland. The new Mexican representative was established in 1900 as a branch of the Isaac Joseph Iron Company of Cincinnati. The present company was organized in 1907.

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Graybar Electric Company has been appointed distributor of the complete Miller line of ultraviolet Sunlite equipment in the eleven Western states, according to announcement of Henry C. Hubley, Western sales manager for the Miller Company, Meriden, Conn.

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The Electrolux Company, Stockholm, has announced net profits for 1931 of 7,073,000 kronor, against 8,042,000 for 1930. The directors propose to pay a dividend of 8 per cent, against 9 per cent for the previous year. The reserve fund is brought this year up to the maximum required by law at 6,000,000 kronor, being 10 per cent of the share capital, and 1,282,000 kronor remain to be carried forward after all writing off, tax and reserve fund allocations, and dividend payment.

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Products of the Lightolier Company of New York, manufacturer of lighting fixtures and lamps, will be manufactured at the plant of the Standard Bronze Company, Ltd., Toronto, Ont., and the factory is being enlarged and equipped to accommodate the new line. A Canadian subsidiary, Lightolier, Ltd., has been formed, and John A. Tanner, president of the Standard Bronze Company, is secretary and in charge of Canadian operations.

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John Maddox, Pacific Coast sales manager for the Duplexalite division of the Miller Company, Meriden, Conn., has removed his headquarters from Los Angeles to 639 Mission Street, San Francisco.

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Kaslin & Co., Inc., Syracuse, N. Y., industrial engineers, have opened a second New England office at room 503, 10 High Street, Boston, in charge of Percy J. Wilson, vice-president of the organization and formerly sales manager of the Narragansett Electric Company, Providence. For the present Mr. Wilson will also maintain quarters at the Providence offices of the Kaslin company.

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William S. Wilbraham, who has been in charge of the estimating and order department of Lukenweld, Inc., Coatesville, Pa., since the organization was established in 1929 to manufacture welded parts for machinery and equipment, has been appointed assistant manager of sales and will work directly with Henry H. Peck, manager of sales.

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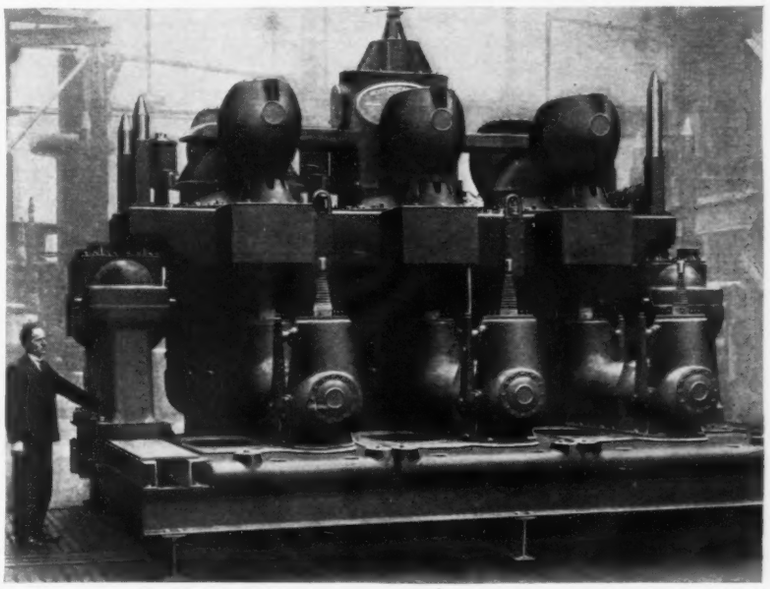
66-KV. SWITCHGEAR INTERRUPTS 1,500,000 KVA.



Similar in design and appearance to the circuit breaker shown above, 50 other metal-clad units have been provided by Metropolitan-Vickers Electrical Company for the new Battersea generating station of the London (England) Power Company. The breakers are of the lift-up type. Ratings are for 800 and 1,200 amp. Said to be the largest and highest voltage units of this type to be constructed, that illustrated weighs about 20 tons.

New Equipment Available

Instrument Board Marks Irradiated for Safety

So simple an expedient as the screening of an ordinary instrument panel light to remove all but the ultraviolet rays has brought increased safety to airship travel. A special glass lens placed over the mouth of a small reflector spreads the light so that it takes in all of the surface of the dashboard. It is equipped with a two-filament automobile headlight lamp, which adds a factor of safety against light failure. If one of the filaments happens to fail during the flight the pilot can merely throw a switch which will pass current through the good remaining filament and thus keep a continual source of ultraviolet.

Stray light coming from the dashboards in the cockpits of small planes and in the pilot compartments of the larger ships is particularly objectionable when landing as it makes it difficult to distinguish airport signal lights. Even the dimmest light in the pilot's seat is many times brighter relatively than the darkness surrounding the plane, a factor which makes it difficult for him to judge quickly and accurately distances ahead and to the side.

The principle of this new lighting developed by Westinghouse is based on the fluorescent quality of radium paint and the characteristic of ultraviolet rays to make certain substances glow with greater brilliance. Heretofore the natural fluorescence of radium, even assisted with artificial light, has failed to solve this problem of good dashboard visibility during the twilight hours of the day.

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A NEW TYPE STENCILING OUTFIT, furnished with or without ink-drying attachment, is announced by the Everhot Manufacturing Company, Maywood, Ill. The self-inking stencil is on a cylinder which rolls against the stencil cylinder. This outfit is furnished with an electric heating element if desired. When plugged into any electric socket the stencil gets hot enough to dry and set the ink instantly as applied. The heating element is valuable for stencil-branding products or containers when moist, or for stencil-branding oiled paper or meat products. The heating element used is of just sufficient size to dry the ink instantly and not burn.

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A COMPLETE LINE OF GRAPHIC RECORDING INSTRUMENTS the spring clocks of which drive the chart, and made of removable units, escapement, spring barrel and gear train, is announced by the Esterline-Angus Company, Indianapolis, Ind. These interchangeable clock units can be quickly dropped out and replaced in the field without putting the instrument out of service. The entire line comprises 22 different kinds of recording instruments, including a.c. and d.c. ammeters, a.c. and d.c. wattmeters, a.c. and d.c. voltmeters, speed recorders, vacuum recorders, high- and low-pressure recorders, frequency- and power-factor recorders, time and production recorders, motion and position recorders and water-level recorders.

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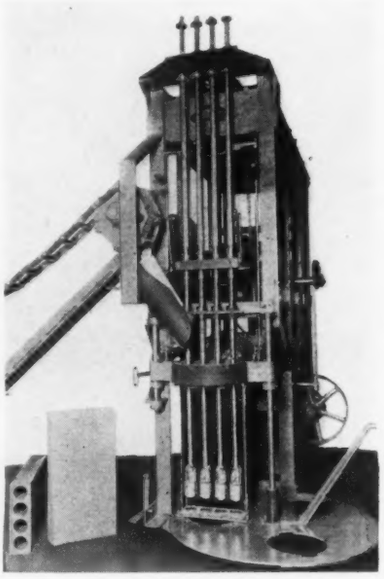
Conduit for Low- and High-Tension Cables

Two new designs of conduit, one for low-tension and the other for high-tension cables, have been perfected by the



McCracken Machinery Company, Sioux City, Iowa. The concrete units are said to be non-fusible, with extremely smooth interiors. Made in 4-ft. lengths and packed densely, they are claimed to have unusual strength. The method of compacting the concrete is the packer head process developed years ago by the McCracken company and still used in the manufacture of concrete sewer, drain and culvert pipe. The packer heads revolve in a stationary mold, the head consisting of a double eccentric packing element and followed by a troweling element. The semi-dry concrete is packed against the mold wall by a wedging action, and the result is a concrete which, when adequately cured, develops a crushing strength of more than 4,000 lb. per square inch with less than 8 per cent absorption and waterproof resistance against 15 lb. hydrostatic pressure.

In addition to achieving great density of product, the packer head contributes to the extreme accuracy required to make ducts register. It operates like a cylinder-boring mill in gas engine manufacture. The ducts are perfect circles in cross-section and the taper slip joints assure perfect alignment in laying.

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Combined Expansion Tank and Relief Device

A transformer expansion tank and relief device combined into one unit which permits the use of a relief device larger than would otherwise be the case is announced by the Allis-Chalmers Manufacturing Company. The two devices function quite independently of each other.

The relief device consists of a short, straight pipe of large diameter passing directly through the expansion tank. Over the upper end of this pipe is a hinged cap held closed and made airtight against a cork gasket by means of small holding-down bolts. These bolts are designed to break and permit the cap to open under a relatively slight internal pressure. When in the open position the cap is unstable, so that it recloses and prevents entrance of rain or other foreign material.

The expansion tank is mechanically supported by the relief pipe and is connected with it by a small pipe through which there is an interchange of oil between main tank and expansion tank under changing temperature conditions. A valve is provided in this connection so that the oil in the expansion tank may be isolated from the oil in the main tank when it is desired to open the main transformer case.

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Watt-Hour Meter for Heavy Overloads and Light Loads

A new watt-hour meter, type OC, in which the electromagnet gives better performance, making for high accuracy from heavy overloads down to extremely light loads, and assuring better performance on variable voltage and temperature, is announced by the Westinghouse Electric & Manufacturing Company, Newark, N. J. To provide for more thermal capacity in the current coils the OC electromagnet has been enlarged. The improved design has extended the range of the meter so that only three current ratings, 5, 15 and 50 amp., are required for self-contained loads. The 5-amp. meter starts on approximately 1 watt and the 15-amp. model on approximately 3 watts, assuring registration of the smallest loads.